BladeRunner Ether-Cut™ User Manual   CandCNC

With BladeRunner AIO SERVO Addendums
UPDATED 3/15/14

Covers BladeRuner Ether-Cut,

Unit pictured is a Bladerunner 620-4
withe DTHC IV upgrade and C3 Bus 4 port hub

INTRODUCTION

The BladeRunner Ether-Cut is a complete CNC motion controller in a single enclosure that consists of

1. **Advanced logic Interface electronics** to connect the signals from a PC and provide bi-directional communication for controlling motion, operator feedback and expanded Input/ouput (I/O). UBOBIII with Port Expansion for single Parallel Port operation

2. **Safety monitoring and auto-shutdown circuits** controlled via embedded processors. Monitors DC (motor) voltage, DC load current and internal temperature. Values displayed on screen.   Less than 1msec total shutdown to out of spec conditions. Fault shutdown codes on Front Panel and on screen.

3. **Exclusive Driver Interface** design monitors each axis independently and protects drives from shorts and overloads. Reports faults with flash code and on-screen in text. Driver interface card has input high speed opto isolation (step & dir).

4. **High quality Gecko stepper drivers** with X10 microstepping and tuned anti-resonance for smooth motion.

5. **High capacity toroid linear power supply** provides low noise DC power with large surge capability. AC input has two levels of ON/OFF. AC side fusing (breaker) DC side Electronic fusing and conventional fusing. Operation on most AC power grids in the world.

6. **Wired and tested motors** are specially designed to match Gecko Drivers for optimized performance

7. **Unit is expandable for up to 5 motors** and drives (full 5 axis independent)

8. **Warranty covers labor and parts** (returned to factory) for a full 2 years. All components including motors and drivers.

9. No Parallel port or serial port needed. Uses one Ethernet (network) port and one USB port (for RS485 C3 Bus hub)

IN ADDITION to the Above the BladeRunner AIO **DRAGON-CUT** offers:

1. Fully integrated Digital Torch Height Control with:
- » Dynamic Fault and anti-dive detection
- » On-screen display and setting of all Torch Height Parameters
- » Full high speed digital response
- » Total electrical isolation for safety and noise rejection
- » Advanced PWM digital pickup at the plasma via a single cable
- » Exclusive HyT-Connect™ SINGLE CABLE plug-n-go interface for all Hypertherm 45/65/85/105/125. Direct Connection kits for most other brands.
- » Industry first DCP-01 (digital current probe) option shows actual cut current on any plasma cutter!
- » Instant recall Stored Settings Library. A Cut Profile that is a dynamic Cut chart stored by material type/thickness.
- » More precise control than any other THC (ATHC; AVHC; AVC;THC) on the market.
- » Only THC with DCC™ and TAP™ for storing and adjusting plasma cut parameters while cutting

2. High quality electronics and same 2 year warranty.

INTRODUCTION: BladeRunner AIO

The setup of the BladeRunner AIO Series Interface involves the installation of MACH3 software and some support files on the PC to be used for the machine controller. UPDATED MANUALS CAN BE FOUND AT: http://www.CandCNC.com/manuals.htm. Always check that location

Familiarize yourself with the controls on the BladeRunner Front Panel and with the loading and operation of MACH3 with the proper profile. The SOFTWARE part of this manual is devoted to getting MACH3 properly installed with the right CandCNC support files and profile to run the BladeRunner AIO Plasma and Router. After you have the software installed and the cables and satellite cards hooked up, you will be guided through a series of tests to determine if everything is working. We ask that you go through the setup and manual in the order presented. If at some point you cannot get the expected results and check your connections and setup with no success, then call our tech support person at 903-364-2740 during normal business hours (posted on the CandCNC website).   Often an email to Tom@CandCNC.com will get a response after hours or on weekends. Another valuable source of help is the CandCNCSupport Group at
http://www.candcnc.net/supportforum
You must have a yahoo membership and you must request to join the CandCNC forum. The Group is open to all persons interested in CNC cutting and/or CandCNC products.

Installation and setup of your BladeRunner AIO ETHER-CUT....OVERVIEW

There are a series of steps you must complete to setup and interface the BladeRunner Ether-Cut AIO with your PC
★
★   **Install and setup the Ethernet Port in your PC**
★   **Install MACH3 software (proper version)**
★   **Install MACH3 license into the MACH3 main folder**
★   **Run menu driven CandCNC Master Installer program from the CandCNC Support disk to load selected custom screens and setup files and Plug-ins**
★   **Open MACH3 and check screens and configurations**
★   **Setup and configure the C3 BIS USB to RS485 serial connection Connect the 2 PC port cables (CAT5) to the side of the BladeRunner ***
★   **Run a quick series of tests to confirm the ports are working and that MACH3 is configured correctly**
★   **Tune and Calibrate the motors on each axis.**
★   **Setup and Test Inputs and Outputs for Homes and Limits**
★   **Check for proper motion**
★   **Proceed to the *DTHC IV Setup & Config Manual***

BLADERUNNER AIO TABLE of CONTENTS
PART 1, SETUP, CALIBRATION . {CONT)

BLADERUNNER AIO TABLE of CONTENTS
PART 1, SETUP, CALIBRATION

THE FOLLOWING CONFIGURATIONS ARE NOT SUPPORTED:

?Any Windows 64 bit install
?WIN 8 or 8.1 (not yet tested)
?Laptops (usable but discouraged for the harsh environment of a plasma shop)

I
Other Limitations:

We have included a version of MACH3 on the Support CD that has been tested and certified to work with our plug-ins and screens.   If you have already installed a LATER version then it MAY work. *If you experience problems with a version **newer** than our version on the CD* then: [SEE THE "*BEFORE YOU UNINSTALL MACH....."* BELOW]

1. Uninstall the newer version of MACH using Windows Software Install/remove program
2. Open the Hardware Manager on the PC and uninstall the MACH PULSING ENGINE device in the hardware list.
3. Do a fresh install of MACH3 and re-install the CandCNC files (INSTALL) off the CD

BEFORE YOU UNINSTALL MACH OR DO A REINSTALL OF THE CandCNC INSTALL OFF OF THE CD

If you have settings you would like to preserve from the earlier install make a copy of the MACH3 folder on your drive using another name or roll it over to a memory stick. The important files will be the specific PROFILES (all have XML extensions on the file name). You can copy the older XML profile over to the new install BUT if there is a bad setting it will transfer that too. One way around this it to open MACH Loader and CREATE a new Profile with a New Name and CLONE it from the profile you are using .You can then copy the Cloned profile back to the install from your COPY of the MACH folder and run it in place of the default profiles created during and install. Even if it does not work right you can move the motor tuning and other setup values from the cloned profile.

PC Requirements & Preparation

B

PC HARDWARE

TO run MACH3 with the Bladerunner Ether-Cut ™ Systems:

1. Pentium 4 PC or later
      2.4 to 3.4 GHz Processor
      512M to 1G RAM
      20G Harddrive
      1280 X 1024 SVGA (no shared system RAM)
      1ea RJ45 8 pin Ethernet Port
      1ea USB port
      Windows XP SP2 or SP3, Windows 7 32 bit.
      Keyboard
      Mouse

2. Optimized Windows setup
      No automatic updates running
      Disable Remote Assistance
      No Virus Checker or background file checkers
      Turn off all non-essential background processes in Windows

5. Disable Power Management
      1. Right-click on your desktop, and then click Properties.
      2. Click on the Screen Saver tab.
      3. Set Screensaver to None.
      4. Press the Power button near the bottom.
      5. Set all options to NEVER shut down automatically! (No Sleep options)
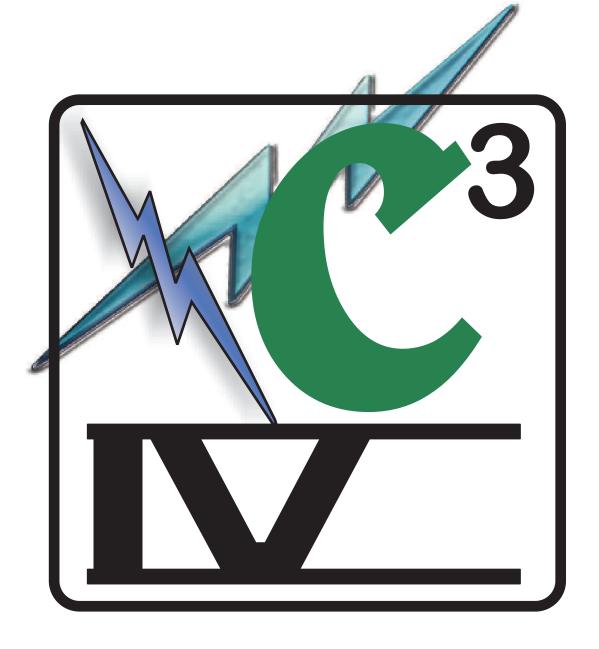
6 Disable Wallpaper
      1. Right-click on your desktop, and then click Properties.
      2. Click on the Desktop tab.
      3. Where it says Background, scroll all the way up and choose None.
      4. Click OK.

NOTE: The Ether-Cut system moves the pulse engine from part of Windows and the PC hardware (parallel port) to a dedicated pulse card that give clean, even pulses to the motor drivers. The overhead to the PC processor goes way down so MACH then becomes a typical program. Windows is not a true multi-tasking OS so we still do not recommend running another active program will MACH is running code but having other applications on the control PC is now okay.

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DTHC IV Screen Set with DCC/TAP flyout using TAB key

NOTE: Screens change as we upgrade certain features and your screen may not look *exactly* like this one but it should be similar.

DTHC IV + Ether-Cut Screen Set with DCC/TAP fly-out using TAB key

System Properties

System Restore | Automatic Updates | Remote
General | Computer Name | Hardware | Advanced

System:
Microsoft Windows XP
Professional
Version 2002
Service Pack 3

Registered to:
TOMC

Computer:
AMD Athlon(tm) 64 X2 Dual
Core Processor 5800+
3.01 GHz, 2.00 GB of RAM
Physical Address Extension

OK

System Properties

System Restore | Automatic Updates | Remote
General | Computer Name | Hardware | Advanced

Device Manager

The Device Manager lists all the hardware devices installed on your computer. Use the Device Manager to change the properties of any device.

Device Manager

Drivers

Driver Signing lets you make sure that installed drivers are compatible with Windows. Windows Update lets you set up how Windows connects to Windows Update for drivers.

Driver Signing | Windows Update

Hardware Profiles

Hardware profiles provide a way for you to set up and store different hardware configurations.

Hardware Profiles

OK | Cancel | Apply

Device Manager

File   Action   View   Help

- 🖳 TCAUDLE2
  - 🖫 Bluetooth Radios
  - 💻 Computer
  - 🖴 Disk drives
  - 🖵 Display adapters
  - 🖫 DVD/CD-ROM drives
  - 🖫 Human Interface Devices
  - 🖫 IDE ATA/ATAPI controllers
  - ⌨ Keyboards
  - ◇ Mach3 Pulseing Engine
  - 🖱 Mice and other pointing devices
  - 🖫 Monitors
  - 🖳 Network adapters
    - 🖳 NVIDIA nForce Networking Controller
  - ◇ NVIDIA Network Bus Enumerator
  - ◢ Ports (COM & LPT)
  - 🖫 Processors
  - 🖫 Sound, video and game controllers
  - 🖫 Storage volumes

Make sure the Network Adapter does not show disabled or not-working warning symbol!

NVIDIA nForce Networking Controll... ?

General | Advanced | Driver | Details | Power Management

🖳 NVIDIA nForce Networking Controller

Device type:	Network adapters
Manufacturer:	NVIDIA
Location:	Location 0 (NVNETBUS Id: 00070000-000)

Device status

This device is working properly.

If you are having problems with this device, click Troubleshoot to start the troubleshooter.

Troubleshoot...

Device usage:

Use this device (enable)

OK   Cancel

This does not mean the device is actually "working" and will talk to a network or the Ether-Cut. It simply means Windows sees the device and it appears the right drivers are loaded. If you have problems configuring or testing the port it can still be a bad Ethernet card or the wrong card drivers.

CandCNC

NOTE the screens shown are for an NVIDIA Network card and may have different option screens and settings. Most cards have default settings that are correct and do not need to be changed.

When running MACH3 on a computer you MUST turn off all Power Saving options in Windows and make sure the communications device is not set to turn off to save power. This option may not appear on all Ethernet Cards.

Make sure the Local Area Connector does not show it is **disabled**.   It may show it is not CONNECTED but if it is missing or disabled you will need to get the problem resolved before you can proceed with the install.

Network Connections

File   Edit   View   Favorites   Tools   Advanced   Help

Back ·   ·   Search   Folders

Address   Network Connections

Network Tasks

Create a new connection

Set up a home or small office network

Change Windows Firewall settings

Disable this network device

Repair this connection

Rename this connection

View status of this connection

Change settings of this connection

Other Places

Control Panel

My Network Places

My Documents

My Computer

Details

Name

LAN or High-Speed Internet

Local Area Connection 2

Disable
Status
Repair

Bridge Connections

Create Shortcut
Delete
Rename

Properties

Find the Local Area network (there may be wireless networks shown too). Ether-Cut needs a DEDICATED network connection from the ethernet port on the PC directly to the Ether-Cut connector.

Right click and select PROPERTIES from the List Box. The Properties window will display.

Local Area Connection 2 Pro...

General   Advanced

Connect using:

NVIDIA nForce Networking Controller   Configure...

This connection uses the following items:

☑ QoS Packet Scheduler
☑ AEGIS Protocol (IEEE 802.1x) v3.7.5.0
☑ Internet Protocol (TCP/IP)

Install...   Uninstall   Properties

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

☐ Show icon in notification area when connected
☑ Notify me when this connection has limited or no connectivity

OK   Cancel

Scroll to the Internet Protocol device and hit the PROPERTIES button.

Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically
◉ Use the following IP address:

IP address: 10 . 9 . 9 . 1
Subnet mask: 255 . 255 . 255 . 0
Default gateway:

○ Obtain DNS server address automatically
◉ Use the following DNS server addresses:

Preferred DNS server:
Alternate DNS server:

Advanced...

OK   Cancel

The TCP/IP Properties window will appear.
Make the following changes:

Select "Use the following IP Address"

Type in the IP address exactly as shown (10.9.9.1)

Type in the Subnet mask exactly as shown (255.255.255.0)

Do not assign a Default Gateway (blank)

Do not assign any DNS servers (blank)

Do not use the Advanced button.

A NOTE ABOUT THE TCP/IP Address and the Ether-Cut

The Ether-Cut uses a modified version of the ESS Smooth Stepper™ and the manual for that product should NOT be used for this installation. We have all of the settings (including the IP address of the ESS card) preset and tested at the factory as part of the final system tests we do on all our products. The address of the ESS is 10.9.9.9. It is STRONGLY advised that you DO NOT run this through a hub or have it on a network with other devices. If you need network or wireless connectivity you need to install another device and set that up separately with it's own address and settings. You can run multiple Ethernet cards in the same computer. For the Ether-Cut setup, there is NOTHING you need to change or setup other than the Ethernet port on your control PC. If you cannot get the proper indications or the ping response on the tests and have done all of the CandCNC Ether-Cut installation, than it is most likely a PC related hardware problem. A lot of PC's (Dells in particular) from refurbishers or that have been used with the parallel port version, may have the Ethernet disabled or the proper drivers not loaded. We have found that if you load the wrong driver you may get an indication in the Device Manager the Ethernet card is OK but it still won't communicate. Windows does no testing for functionality of ANY device. It just confirms it is there. If you cannot get your Ethernet port to function properly then you should check and see if there are driver updates for your PC and the Ethernet Card you have.
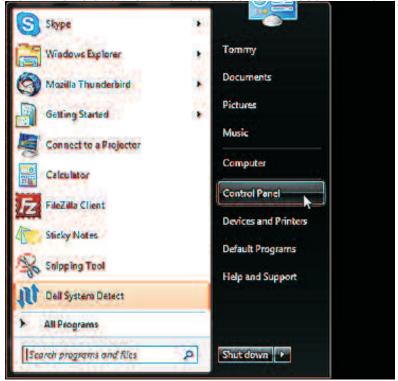
The procedure for setting up the Ethenet address and settings on Windows 7 for the Ether-Cut are very similar to those for Windows XP shown in the previous pages. The process of getting to the Network Connections is a little different.

A NOTE ABOUT USING WIN 7 with MACH3. **You must use a 32 bit version of Windows 7** to run MACH3 and the Ether-Cut. You cannot use WIN 7 64 bit running in 32 bit emulation.
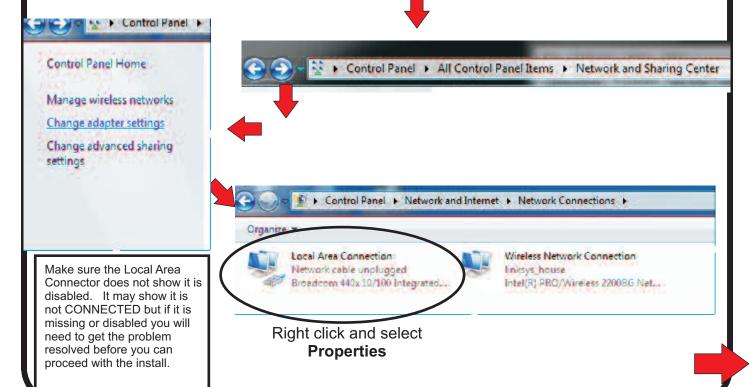
Select Control Panel from Start Menu.

Select Network and Sharing Center from the Control Panel Full Menu.
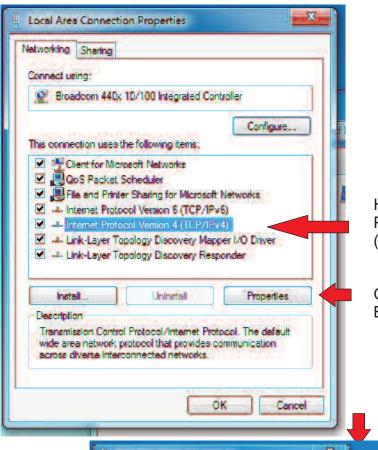
You will get a graphical representation of your network and installed links.

On the left you will see the Change Adapter Settings menu choice.

Make sure the Local Area Connector does not show it is disabled.   It may show it is not CONNECTED but if it is missing or disabled you will need to get the problem resolved before you can proceed with the install.

Right click and select
Properties
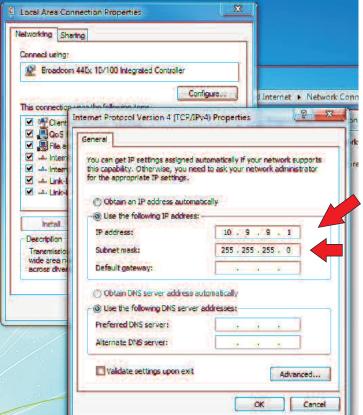
Highlight Internet
Protocol Version 4
(TCP/IPv4)

Click Properties
Button

Select **Use the
Following Address**

**Enter the address
exactly as shown
10.9.9.1**

**Enter the Subnet
Mask exactly as
shown
255.255.255.0**
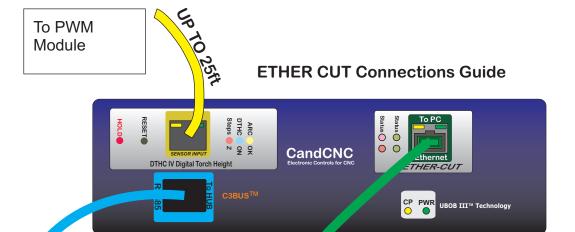
**Leave all other
settings blank
(no DNS servers)**

Click OK to save

CandCNC

ETHER-CUT
INSTALL

To PWM Module

UP TO 25ft

ETHER CUT Connections Guide

HOLD RESET SENSOR INPUT Steps Z DTHC ON ARC OK CandCNC Electronic Controls for CNC Status Status To PC Ethernet ETHER-CUT

DTHC IV Digital Torch Height

RJ-85 To HUB C3BUS™

CP PWR UBOB III™ Technology

UP TO 25ft

Green Cat5 from Ethernet Jack on Ether-Cut front panel TO Ethernet jack on PC. Up to 25ft length.

BLUE CAT5 cable for RS485 from C3BUS Jack on Ether-Cut to

Ethernet Jack

CAUTION: All cables are CAT5 UTP 8 conductor and will plug into any CAT 5 (RJ45) jack. We have color coded the cables to help keep them from being mis-connected. If you use other CAT cables be sure to label them on each end. Connecting cables wrong could damage modules.

UP TO 25ft

USB PORTS

CandCNC C3BUS RS485 4 Port Hub

PWR Con ACT USB
CandCNC
RS485 4 PORT HUB
ACTIVITY MONITOR
To Hypertherm RS485 PORT (ONLY) C&C 1 C&C 2 PN200
1 2 3 4

6 ft or less

HUB is REQUIRED for DTHC IV

CONTROLLER PC RUNNING MACH3

CandCNC
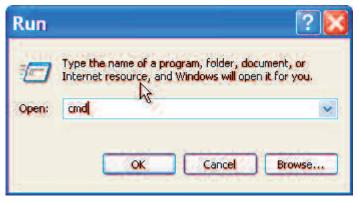
OPTIONAL TESTING OF THE ETHERNET PORT

TESTING Your IP address:

To do this test you must have the Ether-Cut connected to the Ethernet jack on the PC. You should see the yellow LED on the JACK (RJ45) of the Ether-Cut come on steady as soon as the two are plugged in together and both powered up. This LED indicates there is a physical connection (the cable is good and both ends are connected and have power). It DOES NOT indicate the two are actually talking (sending data). The Green LED does indicate activity (both send and receive) so while it may confirm there are packets going one way it does not indicate there is full bi-directional communications.


```
Run
Type the name of a program, folder, document, or
Internet resource, and Windows will open it for you.
Open:  cmd
        OK      Cancel      Browse...
```

```
C:\WINDOWS\system32\cmd.exe

Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\tommy>ping 10.9.9.9

Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.9.9.9  bytes=32 time=28ms TTL=249
Reply from 10.9.9.9  bytes=32 time=30ms TTL=249
Reply from 10.9.9.9  bytes=32 time=26ms TTL=249
Reply from 10.9.9.9  bytes=32 time=29ms TTL=249

Ping statistics for 10.9.9.9:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 26ms, Maximum = 30ms, Average = 28ms

C:\Documents and Settings\tommy>_
```
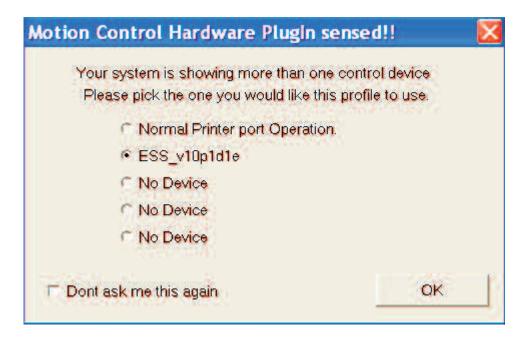
Motion Control Hardware PlugIn sensed!!

Your system is showing more than one control device
Please pick the one you would like this profile to use.

- ◌ Normal Printer port Operation.
- ◉ ESS_v10p1d1e
- ◌ No Device
- ◌ No Device
- ◌ No Device

☐ Dont ask me this again   OK
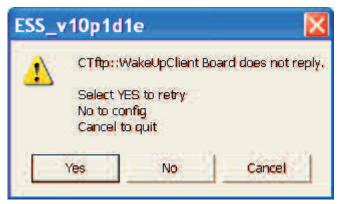
When you open the Ether-Cut Profile for the first time you should see the
dialog box above. MACH should recognize the ESS Ethernet device and
ask you if you want to use it instead of the Parallel Port (You DO!).
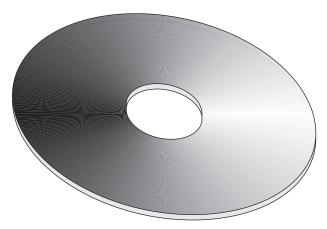
If you DO NOT see the dialog box and MACH opens then it may have
already been set. If the ESS fails to load and you cannot get the screens
in the **Plug-in Control menu** then use the top menu bar and the
Functions Cfg's menu and select the **Reset Device Set** option. Stop and
restart MACH. If you get an error message like

ESS_v10p1d1e

⚠ CTftp::WakeUpClient Board does not reply.

Select YES to retry
No to config
Cancel to quit

Yes   No   Cancel

MACH does not see the ESS Ethernet Device and you need to go back
through the IP setup and the tests to make sure the card is communicating
with the PC Ethernet port.

SOFTWARE INSTALL SETUP

BLADERUNNER AIO SUPPORT CD.

● Contains Master Installer (Auto Install File) to automatically load Drivers (Plug-ins), Custom Screens, and Custom Profiles for router and plasma.

● Contains (This) Complete Manual for BladeRunner and all associated Manuals for internal cards.

● Contains tested rev level of MACH3 software (Unlicensed DEMO VERSION).

● Contains MACH3 SheetCAM and Hyt_Connect RS485 Licenses **if purchased with the Bladerunner.** Auto installer allows any one or all to be automatically installed from the CD if they are on it.

● Contains sample artwork for plasma and router (CDR format).

● Contains freeware drawing program (Inkscape) that will open and let you edit the ™ CDR sample files.

● Contains Demo version of DXFTools for smooth arcs and curves from CorelDraw DXF export.

● Contains Demo version of SheetCAM.

● Contains Support Installer for SheetCAM. Adds in custom POSTS and Tool Sets

READ THESE NOTES!

It helps to have a basic understanding of how MACH operates, what it does and how it combines with the BladeRunner Hardware to generate motion.

● **There are 3 distinct parts (legs) of CNC:** CAD(Drawing), CAM (Toolpathing) and CONTROL (operation of the hardware and operator interface. **MACH is the third and last (CONTROL)**. It does not generate toolpaths from a file; it cannot be used to draw or edit artwork. It runs a specific "dialect" of G-Code.

● **Specific software programs are used for the CAD**(drawing) to generate the base artwork in vector format. For simple shapes a pure CAD program can be used. For artistic, decorative or signage type cuts, a drawing program that allows drawing in vector format (lines) will better fit the needs and is a lot faster than pure CAD. It will allow import of several Vector type formats to allow you to use vector clipart (like the files found at www.VectorArt.com) The two most popular drawing programs are CorelDraw (any version after 11) and Adobe Illustrator. A FREE alternative is Inkscape and is included on our Software CD. You can download it from http://inkscape.org/download/?lang=en

● **The CAM process takes a drawing file and allows the user to import it** in line format, define the objects to cut and in what order, with which tool and what type of cut. Better CAM programs have automatic lead-ins/outs (essential for plasma) and cut type settings. The most essential piece is the "POST" processor that translates the CAM program's native toolpath data to standard G-Code in a form that matches your control program (MACH3). The best value and most flexible CAM for 2 D or 2.5D cutting is SheetCAM. It is available at www.SheetCAM.com. SheetCAM TNG is a part of our Software Bundles

● **Some programs combine CAD and CAM or CAM and CONTROL** but they typically are a compromise and one or more section will not be as robust as the other. To maintain maximum flexibility, and not be placed in a position where you have to change out an expensive tool (or quit using a section), it is recommended you run separate applications for each "leg" of the CNC Triad. You can then pick and choose the features from each one that best suit the type cutting you do.

● **MACH uses setup "Profiles" stored in the main MACH3 Folder** as an XML file. It stores all of the settings about the hardware and interface (input pins, output signals and pins) motor tuning and travel directions. We use a term called "mapping". It refers to defining a specific function to a specific port and pin setting in MACH. The BladeRunner Install copies the "profiles" needed to the MACH folder to run the Bladerunner Hardware. Certain settings that are specific to you machine (motor tuning, travel directions.etc) have to be entered during setup. The settings get stored in the current running PROFILE.

●**The screen presentation for the BladeRunner is in the form of a custom screen "set".** The file is stored in the MACH3 Folder and has a .set extension. It controls what buttons, readouts (DRO's) and bitmaps (pictures) are on the screen. The visual look is controlled using custom bitmaps. Bitmaps used with CandCNC screens are all stored in a folder located in the Bitmaps Folder (under MACH3) and in a sub-folder named CandCNC. With the exception of certain custom objects in a screen there is no setup information. Certain operations on the Bladerunner (parameter feedback and DTHC or Spindle Speed functions) MUST use the associated screen set to operate properly.

●**The G-code runs in MACH** and gives it moves in absolute (measured from a beginning zero point) XY and Z coordinates. It's up to MACH to process the file, do the math and based on the settings in the Profile, issue the proper number of pulses (steps) and proper direction (dir) to the motor drive modules (hardware). There is no positional feedback between MACH (software) and the table position (Hardware). MACH is not "closed loop". It issues the signals at the rate set by the motor tuning rules and it's up to the hardware to move to that location.

Installing MACH3 and the custom BladeRunner files

The actual installation of MACH3 software is straight forward since the file is downloaded from CandCNC support CD and the file when clicked on will take you through an install of the software on your machine. We have included an unlicensed version (demo) of MACH 3 that is needed to use with the BladeRunner series of devices **DO NOT TRY TO USE AN OLDER (EARLIER) VERSION THAN WHAT IS INCLUDED ON THE SUPPORT CD** While we can answer questions about the proper interface of our BladeRunner with MACH3, the actual setup and use of MACH3 on a specific PC may better be handled through the actual software provider or the support list. Our custom files provided on our install disk should setup the PC to work correctly with the BladeRunner, but be aware that changes you make to setup parameters after the install make changes to the profile. **Make a copy of the BladeRunner XML files in the MACH folder (backups) when you have finished setting up the unit. It will save you a lot of time and frustration if you ever need to recover from PC hardware problems**. Any time you make setup changes to a profile then refresh the backup. Store it and your MACH license file on an external device.

We have included a version of the MACH3 Manual on the CD. Do not use it as you primary manual for the setup and realize there are settings in the BladeRunner that should not be changed or it may cease to operate. In most cases you will not need to referernce that manual.   For plasma cutting most of the information is not needed and if there is a conflict between a plasma specific setup or procedures, (this) Bladerunner manual should prevail.

The following pages will take you through the install and setup of you CONTROL PC. First you will install MACH3 then run the Master installer to do a custom setup for MACH for the BladeRunner and the DTHCII or DTHCIV. Detailed setup and testing of the DTHCII is a separate manual on the CD titled DTHCII Manual.   Detailed setup and testing of the DTHC IV is a separate manual on the CD titled DTHC IV Setup and Config Manual.
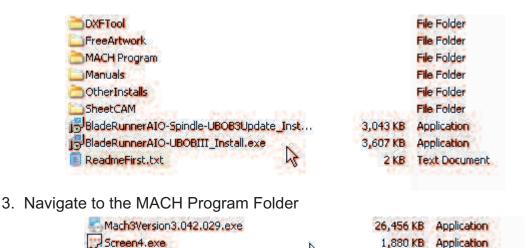
NOTE: THE MP3000 products use the same interface electronics and DTHC as the BladeRunner
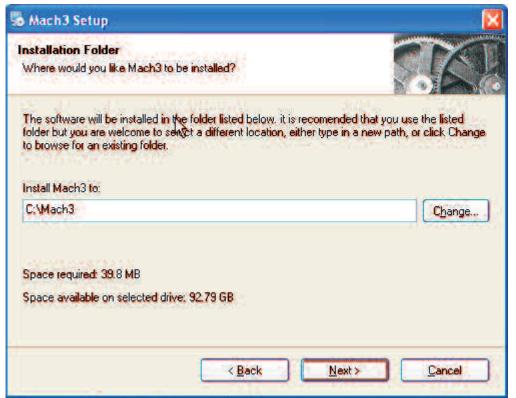
INSTALLING MACH3 FROM THE SUPPORT CD TO YOUR CONTROL PC

1. Locate the Support CD (same one this manual is on) and open the Main Folder (Root) of the CD drive. Use Windows File Explorer or My Computer and navigate to the CD Drive onthe PC
2. Open the CD and the folling structure should be displayed:

DXFTool	File Folder
FreeArtwork	File Folder
MACH Program	File Folder
Manuals	File Folder
OtherInstalls	File Folder
SheetCAM	File Folder
BladeRunnerAIO-Spindle-UBOB3Update_Inst...	3,043 KB Application
BladeRunnerAIO-UBOBIII_Install.exe	3,607 KB Application
ReadmeFirst.txt	2 KB Text Document

3. Navigate to the MACH Program Folder

Mach3Version3.042.029.exe	26,456 KB Application
Screen4.exe	1,880 KB Application

4. Double Click the Mach3Version3./042.029.exe line. The sutomated install of MACH will start

Mach3 Setup

Installation Folder
Where would you like Mach3 to be installed?

The software will be installed in the folder listed below. it is recomended that you use the listed folder but you are welcome to select a different location, either type in a new path, or click Change to browse for an existing folder.

Install Mach3 to:

C:\Mach3   Change...

Space required: 39.8 MB

Space available on selected drive: 92.79 GB

< Back   Next >   Cancel

MACH will ask you for the default installaion Disk and folder to use. SELECT THE STUCTURE IT SHOWS. DO NOT CHANGE IT OR OTHER INSTALLA MAY NOT WORK CORRECTLY

Mach3 Setup

Select Packages
Please select the program features that you want to install.

Program Features:
- [ ] Parallel Port Driver
- [ ] Wizards
- [x] XML's
- [ ] LazyCam
- [+] [ ] Screen sets

Installs the Parallel Port Driver. This is not needed for external motion control devices. (328 KB)

Total space required: 33.7 MB

< Back   Next >   Cancel
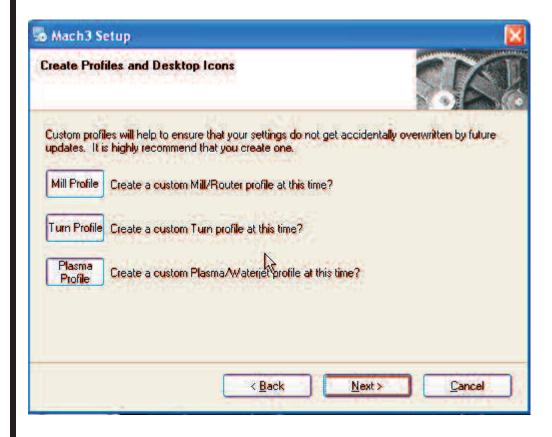
Several Features will be selected by default (checked) Turn off Wizards, LazyCam You can turn off Screen sets unless you want to use the Default MACH screens to build your own screens (experienced MACH users ONLY)

If you are installing the Ether-Cut Make sure you Turn off the Parallel Port Driver . Hit the NEXT button

Mach3 Setup

Create Profiles and Desktop Icons

Custom profiles will help to ensure that your settings do not get accidentally overwritten by future updates. It is highly recommend that you create one.

Mill Profile — Create a custom Mill/Router profile at this time?

Turn Profile — Create a custom Turn profile at this time?

Plasma Profile — Create a custom Plasma/Waterjet profile at this time?

< Back   Next >   Cancel

Do not create any profiles in this screen. All of the Profiles you will need for the BladeRunner System will be automatically created in the next section of the software install section

MACH FILE STRUCTURE

SAMPLE FOLDER STRUCTURE:

Some folders are added for specific options so your folder view will not have all of the ones shown on an initial install. The important ones are listed below

This is located on the C:/ drive of your Control PC.

- Mach3
  - Addons
  - Bitmaps
  - Brains
  - Flash
  - GCode
  - Help
  - **macros**
    - BladeRunnerAIO-DTHC-UBOB3
    - BladeRunnerAIO-Router-UBOB3
    - DTHCII-HyTConnect
    - DTHC-IVSuperTHC
    - ETHER-CUT+TAP
    - EtherCutRouter
    - Mach3Mill
    - MP3000-Basic-UBOB3
    - MP3000-DTHC-UBOB3
    - MP3000Router
    - MP3100Router
    - MP3100-Router
    - MP3100-Router.xml
  - OlderScreens
  - PlugIns
  - Subroutines
  - TurnAddons
  - Uninstall
  - xmlbackups

FOLDER	CONTAINS
Bitmaps	Contains Bitmaps (custom backgrounds and Buttons) for the custom screens. CandCNC has a Folder under Bitmaps for the specific bitmaps for our screens
GCode	Sample G-code for ROUTER. Do not use except for testing motion it will not work with plasma
Macros	Contains Sub-folders of macros for EACH generated Profile. In the specific sub-folder that are macro files. **When you call a macro by number from code or internally it uses the specific macro in the folder of the same name as your running profile.**
Plugins	A folder of plugins installed. The base plugins for CandCNC are the ccc_comm and the ccc_ubob. Others are installed with options like the PN200. Every plugin the folder will be "seen" by MACH. **The Configuration of a plugin including enabled and disabled is stored in the specific XML (profile) so they can be differnt configurations in different profiles**
xmlBackups	Backup copies of the Profiles XML's for your system. Can be renamed and copied back to the MACH main folder to bring back a damaged XML. You should STILL perform file backups onto another media source of your XML files anytime you **change settings.**

From time to time if you add features or certain upgrades are installed there can be added folders and/or changes to files. We make available specific files that upgrade files in this structure. In some cases the user must open the specific folder and copy the new file into (or overwrite an existing file) in a folder. Being familiar with the structure makes this process easier
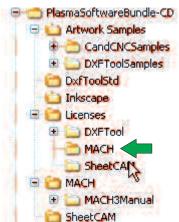
INSTALLING THE MACH 3 LICENSE *SEE UPDATE NOTES

1. Locate your Software Support CD.   It is a separate CD from the Support CD.   If you purchased either of the CandCNC Software bundles you should have the Software Support CD

A NOTE ABOUT THE MACH3 LICENSE FILE:

The Mach1Lic.Dat is an Encrypted file. You CANNOT open it. It must be copied intact using the steps below. Each License file has a unique serial number issued to CandCNC. We keep a database of all licenses and in the event you misplace your license contact us and we can issue a replacement.

2. Open the Software Support Cd to the top folder (root) and click on the README FIRST .txt file. It will open in NOTEPAD. It will explain the licenses and the way CandCNC can issue licenses.
If you already have a MACH license or have bought from another source the procedure is the same but the location of the license file will be different
3. Select the Licenses Folder and then the MACH folder under that

If you have purchased a MACH3 license or Software bundle from CandCNC then In that folder you will find a single file.
NOTE the new Master Installer V and later has an option dutin the process to auto-install your licenses fIF YOU BOUGHT THEM WITH YOUR BladeRunner

To license MACH3 (Manually).
1. Use File Explorer and RIGHT CLICK on the Mach1lic.dat file and select COPY (this copies it to the Windows clipboard)..
2. Immediately Use File Explorer to navigate to the C:/MACH3 folder on your system Hard drive (C:). Right click the MACH3 folder in File Explorer and select PASTE from the menu. That will copy the file in the MACH3 main folder on your control PC.
3. Open the MACH3 folder and display a list of the files in the righthand portion of the Screen. Make sure the Mach1Lic.Dat was copied.

NOTE: MACH will load and run in DEMO mode without a license. It is fully functional with the exception it will only run about 500 lines of code and advanced features like the THC logic are not functional. **You MUST have a valid license loaded before you can use the DTHC IV in MACH.   The Ethernet Pulse card (ESS) may not load and run on an unlicensed MACH install**

This method of install covers **customers that have purchased a Software Bundle at the same time as their equipment.** The MACH3 license and SheetCAM license can be installed automatically using the MASTER INSTALLER. As part of the install you can select to install either or both licenses. You can come back later and use the Master Installer to install other options including the software licenses

☐ Install SheetCAM Support Files (POSTS & Toolsets)	0.3 MB	
☐ Install MACH license	0.1 MB	
☐ Install SheetCAM License		
☐ Install Hyt-Connect TAP License		

NOTE: WE DO NOT recommend installing SheetCAM on the same PC you use to run MACH3 and your table if you are using the Parallel Port setup. MACH3 needs 100% of the available resources and having other applications or their related run-time drivers may cause problems with the pulse train out of the parallel port. You can use the same CD and Master Installer Menu to Install the SheetCAM Support Files and SheetCAM TNG License on the PC you draw and use CAM.

THE FOLLOWING PAGES COVER THE INSTALL OF THE BLADERUNNER CONFIGURATION FILES FROM A MASTER INSTALL (EXE) FILE

The Master Installer Auto Installer Files will automatically load all of the CandCNC support files for MACH3. You must have MACH 3 (version 3.43.067) off this CD installed and running first THEN run the appropriate selections off the Menu.

The installers will load both the Router and Plasma profiles and both ICONs will show up on your Desktop. Each profile for MACH (XML) stands alone so if you want to use both you must setup both profiles with the Motor Tuning and any other parameters that are exclusive to your machine

For reference the full MACH3 Manual is in the Manuals Folder. You will also find the BladeRunner AIO Manual there as well. We also post the latest manuals on our website http://www.CandCNC/com/Manuals.htm. Expansion Cards (DTHC II & DTHCIV) have their own manuals for install, setup and use.

If you have purchased the BladeRunner AIO Dragon Cut for plasma cutting you will also need to refer to the DTHCII _Setup-Config .pdf
All Manuals are in PDF format. You will need to have the Adobe PDF Reader Or something like Foxit) installed (Free) to view or print the manuals.

IF YOU DO NOT HAVE THE SUPPORT CD or it is more than 30 days since you received your BladeRunner you should check http://www.CandCNC.com/Manuals.htm for the Master Installer (ZIP) at the bottom of the page. You can download, unzip and run that installer

STRUCTURE OF THE SUPPORT CD.

Name	Size	Type	Date Modified
MachInstaller		File Folder	1/30/2014 9:11 AM
Manuals		File Folder	1/30/2014 9:11 AM
PN200-Macros		File Folder	1/30/2014 9:11 AM
SheetCAM TNG Program Install		File Folder	1/30/2014 9:11 AM
SheetCAM-CandCNC-Support		File Folder	1/30/2014 9:11 AM
SoftwareBundle-Bonus PAK		File Folder	1/30/2014 9:11 AM
MasterInstallerV_install.exe	10,722 KB	Application	1/29/2014 1:23 PM
WHAT TO DO FIRST-READ.txt	3 KB	Text Document	1/27/2014 11:44 AM

Version of Master Installer is a Roman Numeral ("V" in this case = 5 decimal) and will increment with each release. Check the website Manuals Page for the latest release. NOTE THE WHAT TO DO FIRST-READ.txt. open that file with Notepad and it will give you the latest basic instructions or changes

Master Installer, **What it DOES:**

1. Copies two PROFILES (XML's) to the MAIN MACH Folder for each product selected
2. Copies several Screen SET files to the MAIN MACH Folder depening on the Menu selection
3. Creates a folder under MACH3/Bitmaps named CandCNC
4. Copies all of the bitmaps for the MACH screens to that folder
5. Copies the custom drivers (PLUGINS) to the MACH3/Plug-in folder
6. Opens the MACH3/macros folder and creates a folder for each Mach Profile added in step 1
7. Removes default MACH profile links (Icons) from the Desktop
8. Installs any specail drivers like the C3BUS Hub and the Hub Utility for products that need that

WHAT IT DOES NOT DO:
Load or install MACH3
Load or install any other software
Setup the MACH3 Profile (i.e motor tuning, axis slaving, etc) for your specific table/machine
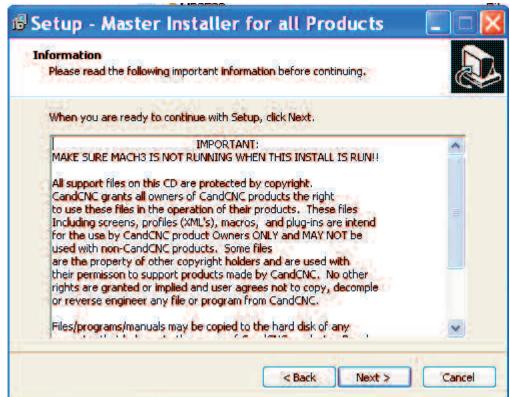
TO START THE INSTALL FROM THE CD OPEN THE CD TO THE STRUCTURE in the ROOT folder of the drive and double click the MasterInstaller[V].exe file. The install will start with a series of windows. In most screens you will just hit NEXT.

Setup - Master Installer for all Products

Information
Please read the following important information before continuing.

When you are ready to continue with Setup, click Next.

IMPORTANT:
MAKE SURE MACH3 IS NOT RUNNING WHEN THIS INSTALL IS RUN!!

All support files on this CD are protected by copyright.
CandCNC grants all owners of CandCNC products the right
to use these files in the operation of their products. These files
Including screens, profiles (XML's), macros, and plug-ins are intend
for the use by CandCNC product Owners ONLY and MAY NOT be
used with non-CandCNC products. Some files
are the property of other copyright holders and are used with
their permisson to support products made by CandCNC. No other
rights are granted or implied and user agrees not to copy, decomple
or reverse engineer any file or program from CandCNC.

Files/programs/manuals may be copied to the hard disk of any

< Back   Next >   Cancel

Basic information about the CandCNC software and programs. Take a couple of minutes to read the text (as boring as it is) so you will know the details about your CandCNC products. We have made the custom drivers and our software as non-restrictive as possible. It does not limit the resale or use by a legal owner.

Setup - Master Installer for all Products

Select Destination Location
Where should Master Installer for all Products be installed?

Setup will install Master Installer for all Products into the following folder.

To continue, click Next. If you would like to select a different folder, click Browse.

C:\MACH3   Browse...

At least 9.5 MB of free disk space is required.

< Back   Next >   Cancel

If you installed your MACH3 in the C:/ drive on your Control PC as we suggest in the MACH Install, Then just hit the NEXT button on this screen.
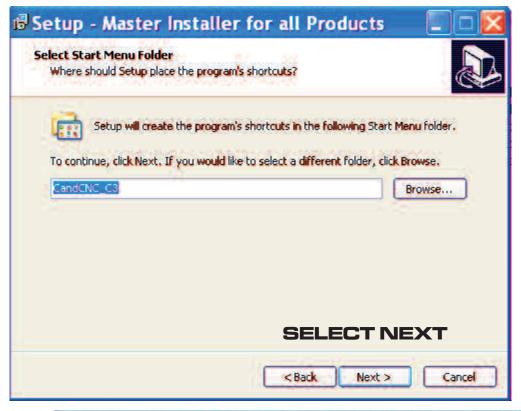
Master Installer Menu System
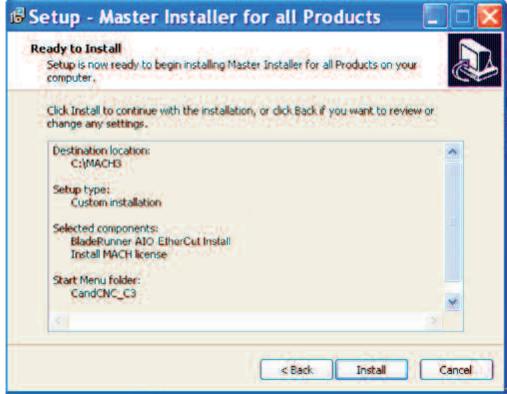
Starting with Master Installer the same installer is used for all CandCNC products and a MENU selection system is used   In version IV and higher the menu has been expanded and the options to load licenses (if you purhcsed them) is included. You will see a much expanded list of products reflecting recent additions to our product line.

You may see this dialog if you have previously installed any components.
Select YES

Setup - Master Installer for all Products

Select Start Menu Folder
Where should Setup place the program's shortcuts?

Setup will create the program's shortcuts in the following Start Menu folder.

To continue, click Next. If you would like to select a different folder, click Browse.

CandCNC_C3   Browse...

SELECT NEXT

< Back   Next >   Cancel

Setup - Master Installer for all Products

Ready to Install
Setup is now ready to begin installing Master Installer for all Products on your computer.

Click Install to continue with the installation, or click Back if you want to review or change any settings.

Destination location:
    C:\MACH3

Setup type:
    Custom installation

Selected components:
    BladeRunner AIO EtherCut Install
    Install MACH license

Start Menu folder:
    CandCNC_C3

< Back   Install   Cancel

Select "Install"

Setup - Master Installer for all Products

Information
Please read the following important information before continuing.

When you are ready to continue with Setup, click Next.

Each of the MACH Profiles You have elected to install will appear in the selection list of MACH Loader. To run any CandCNC equipment you need to start MACH using the Mach Loader or from the Associated CandCNC Icon on the Desktop

It is strongly suggested that you backup your entire MACH folder on the drive to another drive or removable drive
anytime you make a configuration change in any profile. You can recover a lost setup by reloading MACH and simply copying in the XML and Screen files you need.

Next >

Another screen of information we think you should know so humor me and please read it !

Setup - Master Installer for all Products

Completing the Master Installer for all Products Setup Wizard

Setup has finished installing Master Installer for all Products on your computer. The application may be launched by selecting the installed icons.

Click Finish to exit Setup.

< Back   Finish

FINISHED!!

Once you have installed the Master Install file then you can start the final setup, calibration and basic motion tests of your BladeRunner. You can always get back to the basic default values for a BladeRunner if you simply rerun the install again, BUT BE AWARE that any configuration changes (including motor tuning etc) will go back to the install defaults. The following page will cover how you can start the specific PROFILE

STARTING THE BLADERUNNER PROFILE
From the the Desktop on the computer

Look for the C3 Icon and select the Plasma or
Router Profile to run. If the C3 icons are not
present you may find it installed them with a
generic icon like this

it will run from either Icon

HOW TO RUN FROM THE MACH LOADER:

The MACH LOADER ICON should still be on the desktop. It gives you
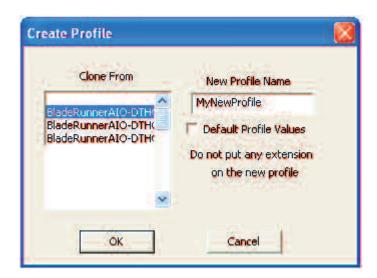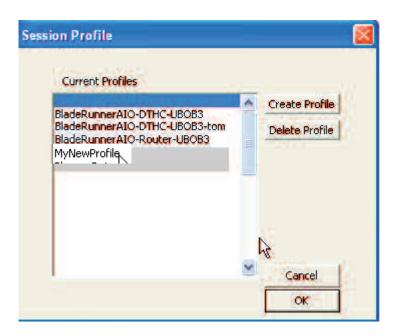access to a MENU of installed profiles that exist on your setup.

Your display may have
more or less profiles than
the screen here. You need
to see at the products you
have selected in the install
menu. The DTHCIV will
have it's own profiles and
screens

**Your screen WILL look
different depending on
what you installed**

There are several things you can do at this point.

1, You can highlight and delete unused profiles.
2. You can highlight and RUN a specific profile by clicking OK after you
highlight the file name in the list.
3, You can Create a NEW profile (see next page)

TO CREATE A NEW PROFILE:

1. Select **Create** from the previous screen you will get a window similar to the one on the left.

2. Type a new name in the input box under **New Profile Name.** Leave the **Default Profile Values** Box UNCHECKED

3. Find a Profile in the **Clone From** List you want to copy all of the settings from.

4. Highlight the File you want to Clone From.

5. Click **OK**

6. The new PROFILE will appear in the selection list. It will have all of the settings of the PROFILE it was Cloned from. It also sets up a folder under the MACROS folder with all of the same macros the original had.

To make new profiles or to change the Profile Name DO NOT simply rename the PROFILE (XML) in the MACH folder. It will show up the list as a new name but there will be no corresponding MACROs folder so you may encounter problems trying the run form that profile
.
IF YOUR RESTORE A PROFILE FROM A BACKUP or ANOTHER SOURCE of the same name it will overwrite the exiting PROFILE and chagne all of the settings to those of the backup.

NOTE: While a profile of another name contains all of the settings you may need to run MACH it lacks the matching Macro Folder created during a Clone. You should first create a Clone of an existing profile using the same name as the file you wish to transfer in and THEN overwrite it with the imported file.

USE THIS SECTION TO INSTALL THE C3BUS RS485 3 PORT Hub if you have the DTHC IV, Hypertherm Advanced Connection Kit (Hyt-Connect RS485 SIM kit) or the PN200 48 function Hand Controller.   The C3BUS will be the universal BUS for CandCNC equipment. New products from CandCNC will utilize the C3BUS. YOU ONLY NEED ONE HUB PER SYSTEM. It is sold bundled or separate. It is REQUIRED for the above listed products.

C3BUS®

INCLUDED IN THIS KIT:

1. USB to RS485 4 Port Hub Module
2. Universal WallPlug Power Supply. 100VAC to 240VAC in, 5V DC out
3. USB A to USB B interface cable (6ft)
4. Installer/driver CD **
5. User Manual (PDF) **
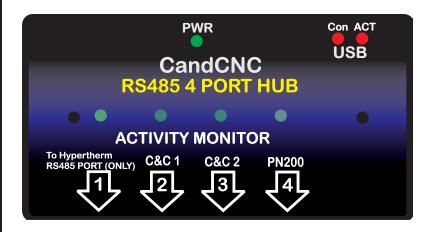
   ** **May be on Master Support CD in RS-485Hub4 Folder**

C3BUS USB to RS485 4 PORT HUB

Handles all secondary (backside) communications to and from the DTHC IV to MACH3.   All screen readouts and all settings to the DTHC IV are handle by the C3BUS. The HUB UTILITY uses the same C3BUS to communicate with all the RS485 modules including the DTHC IV. It is essential the C3BUS be installed and running BEFORE you attempt to setup the DTHCIV.

RS485 4 PORT HUB (TOP VIEW)

PWR

Con ACT

USB

CandCNC
RS485 4 PORT HUB

ACTIVITY MONITOR

To Hypertherm
RS485 PORT (ONLY)   C&C 1   C&C 2   PN200

1   2   3   4
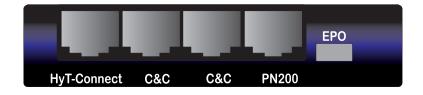
RS485 4 PORT HUB (END VIEW)

RS485
4 PORT
HUB

USB

RS485 4 PORT HUB (FRONT VIEW)

EPO

HyT-Connect   C&C   C&C   PN200

CandCNC

**Universal AC Power Plug
100VAC to 240VAC 50/60HZ
Regulated 5V @ 1A out**

USB ACT LED shows
valid connection to PC
on USB channel

PWR

Con ACT
USB

CandCNC
RS485 4 PORT HUB

ACTIVITY MONITOR

To Hypertherm
RS485 PORT (ONLY)

C&C 1
C&C 2
PN200

1
2
3
4

To EPO on ESP front panel
or EPO on Table I/O

Standard CAT5 UTP up to 50ft

ACTIVITY MONITOR LEDS

When a device is plugged into a
port on the hub the LED will light
if it has proper communications.
It does not mean the device is
operating correctly (see later
pages for using the Hub Utility).
The Activity Monitor shows send
and receive activity on the port

HOLD

RESET

SENSOR INPUT

Steps
DTHC ON
Z

ARC OK
DTHC
OK

CandCNC
Electronic Controls for CNC

DTHC IV Digital Torch Height

RS485

To HUB

C3BUS™

Port1 INPUT

To PC

CP PWR

UBOB III™ Technology
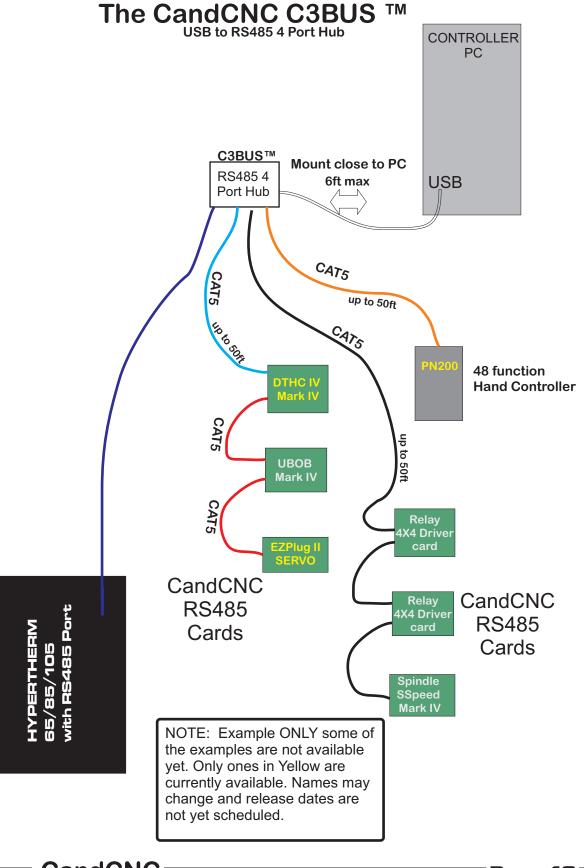
CandCNC DTHC IV (parallel port) system shown

The CandCNC C3BUS ™
USB to RS485 4 Port Hub

CONTROLLER PC

C3BUS™

RS485 4 Port Hub

Mount close to PC
6ft max

USB

CAT5

CAT5
up to 50ft

CAT5
up to 50ft

CAT5

CAT5

CAT5

up to 50ft

PN200

48 function Hand Controller

DTHC IV Mark IV

UBOB Mark IV

EZPlug II SERVO

Relay 4X4 Driver card

Relay 4X4 Driver card

Spindle SSpeed Mark IV

CandCNC RS485 Cards

CandCNC RS485 Cards

HYPERTHERM 65/85/105 with RS485 Port

NOTE: Example ONLY some of the examples are not available yet. Only ones in Yellow are currently available. Names may change and release dates are not yet scheduled.

1. Plug the USB-RS485 4 Port Hub wall plug power supply into an AC outlet.

NOTE: While the wall plug power supply has pins for standard US AC 120VAC sockets the power supply will work and run from any AC power source from 100 to 240VAC 50/60HZ. You can purchase plug adapters from several on-line merchants including Amazon.com for less than $2.00. No voltage conversion is necessary.

2.. Using the included USB A to B adapter cable plug the B plug into the matching jack at the end of the hub and the other end into any open USB jack on the control PC.
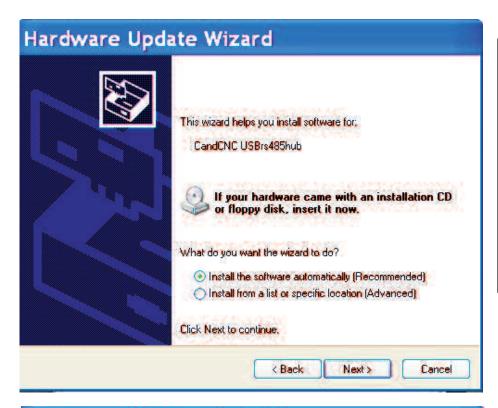
Note: For testing you can load the drivers and CandCNC Hub Utility on any PC or Laptop, but for operation you need to have the hub installed and working in the PC that runs MACH and controls you machine

3... Windows will see the new hardware and will launch the Hardware Install Wizard. Use the following screens to finish the hardware install.

First Screen of Hardware Install(Update) Wizard.

Leave the radio button set on the "No, Not this time" option and hit the Next Button....

Hardware Update Wizard

This wizard helps you install software for:

CandCNC USBrs485hub

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

◉ Install the software automatically (Recommended)
○ Install from a list or specific location (Advanced)

Click Next to continue.

[< Back] [Next >] [Cancel]

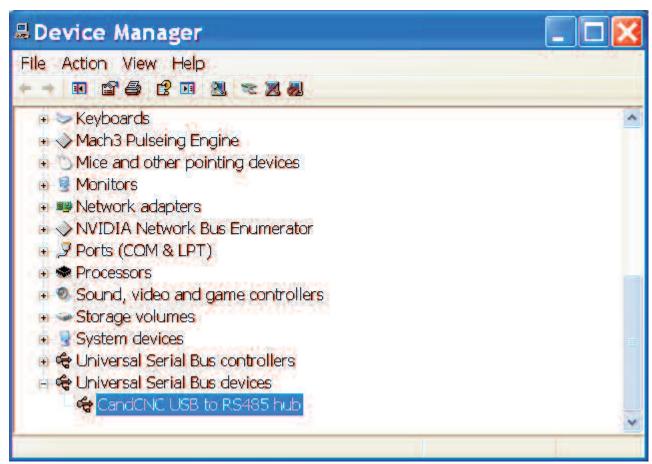Next Screen of Hardware Install (Update) Wizard.

Leave the radio button set on the "**Install the software automatically**" option and hit the Next Button....the driver has already been installed in the earlier steps so you do not need try to find the driver manually

Hardware Update Wizard

Completing the Hardware Update Wizard

The wizard has finished installing the software for:

CandCNC USB to RS485 hub

Click Finish to close the wizard.

[< Back] [Finish] [Cancel]

This screen indicates the software and driver install for the CandCNC USB to RS485 4 port Hub. has been successful

See the following pages for checking the install and to use the CandCNC Hub Utility (Admin)

4. To confirm that your USB-RS485 4 PORT HUB drivers have been installed, open the **System Application** in **Control Panel** in Windows and then the **Hardware Tab** and the **Device Manager.** You will see a "Tree Structure" of hardware devices. Scroll to the bottom and Find the UNIVERSAL SERIAL BUS DEVICES and under it you should see the CandCNC USB to RS485 hub device.   IF YOU DO NOT then unplug the USB connector (either end) and wait 5 seconds and plug it back in. You should NOT get the Hardware Install or Update Wizard . The Device Manager should update and show you the screen below. The CandCNC USB to RS485 hub device will only show up when it is plugged in.
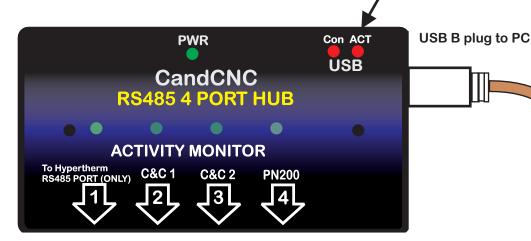
The USB Active (ACT) LED only comes on when there is a valid USB connection to the PC. Drivers have to be loaded and active.

USB ACTIVE LED

PWR

Con ACT
USB

CandCNC
RS485 4 PORT HUB

USB B plug to PC

ACTIVITY MONITOR

To Hypertherm
RS485 PORT (ONLY)   C&C 1   C&C 2   PN200

1   2   3   4

INSTALLING CandCNC RS485 Devices to the USB-RS485 4 PORT HUB

The USB-RS485 4 PORT HUB has an advanced processor that can communicate with several RS485 devices. RS485 is a robust and noise-immune communications standard used in industrial electronics for years. Because of its differential signal methods it is unaffected by external or ground based noise and reliable communications of several hundred feet are common. RS485 is a multi-drop topology meaning there can be multiple devices on the same pair of wires as long as all of the devices operate at the same speed (BAUD RATE) and have a unique address. Since USB is a common port on most PC's it is a logical choice for communications that do not depend on precise timing.

You will note that the USB-RS485 4 Port Hub has four independent channels and each channel can talk to multiple devices, Because of different Baud Rates or special signals the 4 port hub has two special jacks:
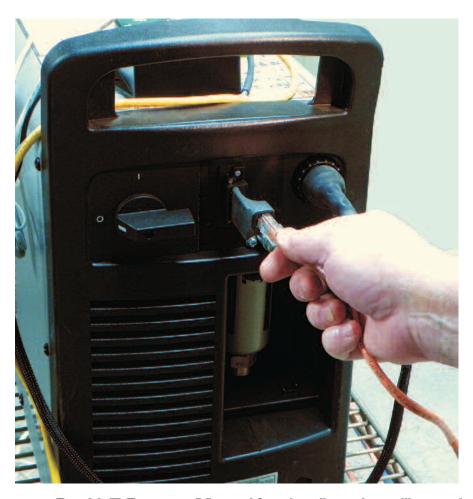
1. **Hypertherm RS485 Port**. This channel runs at a much slower speed and can only talk to a Hypertherm Plasma Cutter equipped with an RS485 port (optional) and through our HyT-Connect RS485 interface. If you already have the HyT-Connect RS485 SIM Kit installed and have the older single port (dual jacks) RS485 module you need to unplug the existing setup and plug the RJ45 (Cat5) cable FROM the port on the rear of the Hypertherm into the jack 1 marked "To Hypertherm Rs485 PORT.

This page shows connection of the optional HYT-Connect RS485 SIM Kit. More detail can be found in the HyT-Connect RS485 SIM Manual. The RS485 option to control plasma cut current is part of the TAP product

Plugging RS485 Hypertherm into RS485 PORT on back of Hypertherm 65/85/105

See HyT-Connect Manual for details on installing and using the RS485 remote control for the Hypertherm and the DCC (Dynamic Cut Control).

2. **PN200 Hand Control.** The PN200 hand control uses normal high speed baud rates but the special "dead man" E-Stop to the EPO of any CandCNC controller requires a special jack. The PN200 MUST be plugged into the PN200 jack to be able to use the E-STOP safety (recommended). The PN200 has to be the last device in a group of devices. The PN200 will worked plugged into other jacks on the 4 PORT HUB (except JACK 1) but you cannot use the E-STOP option. You can also use the PN200 jack on the hub for other RS485 devices if you do not have a PN200. While the PN200 would work with other devices on the channel that have loop through (pass through) jacks the E-STOP to EPO DOES NOT PASS THROUGH OTHER DEVICES.

3. **DTHC IV High Speed Digital Torch Height Control**.   The DTHC IV uses the RS485 (C3BUS) for the following:

. Transfer of screen information to MACH3 like Torch Volts, Torch Amps and the status LED's for Torch UP, Torch DOWN and ARC OKAY. Unlike the DTHC II that uses defined parallel port inputs for the UP, DOWN and ARC OK, the DTHC IV sends the data across the RS485. The only "hard" input from the DTHC IV to MACH3 is the HOLD signal (mapped to INPUT 1 on Ports & Pins).
. Communication to the plug-in in MACH3 to update Z position when DTHC is active(tells MACH3 where the DTHC has moved the Z while under THC mode)
. Pass parameters and settings in MACH to the memory of the DTHC IV. This includes all of the DTHC Cut Profile Settings either from the screen or from the G-code when using DCC

C3BUS® MANAGING THE HUB

During the install the CandCNC Hub Utility was added and an ICON was placed on your desktop. Click on the icon to open the Hub Utility.

IMPORTANT: The purpose of the HUB UTILITY is primarily to confirm proper communication with each device and to be able to do some base level testing .   **You cannot run the Hub Utility at the same time as MACH is running.**
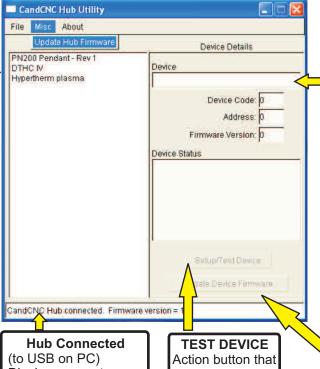
The following screens show the CandCNC Hub Utility displaying information about different devices connected to it. The Hub is "smart" and automatically detects any compatible device connected to it.   Review the screens that follow and understand what each section of the screen is used for.

DEVICE DETAILS

Provides the:
Device Name
Device Code: Each CLASS (type) of device has a different Device CODE. Codes can be from 1 to 99.
Device Address: The unique address of a device within a class (values from 1 to 8). Devices of the same type must have a different Device Address. Future cards will have address jumpers to allow multiple cards of the same type to work on the same hub.
Firmware Version: This displays the current

DEVICES:

Shows a list of connected devices. As a device is connected and sensed by the hub it will appear in the list. If you connect a device and it does not show up immediately, stop (close) the application and restart.

```
CandCNC Hub Utility
File  Misc  About
     Update Hub Firmware          Device Details
PN200 Pendant - Rev 1        Device
DTHC IV
Hypertherm plasma

                            Device Code: 0
                               Address: 0
                         Firmware Version: 0

                         Device Status


                          Setup/Test Device
                        Update Device Firmware

CandCNC Hub connected.  Firmware version = 1
```

Hub Connected
(to USB on PC)
Displays current firmware of the HUB. This MUST show connected status before any other of the functions will display.

TEST DEVICE
Action button that opens a new dialog window. You must have a device highlighted in the Devices List to use the Setup/Test Device

Update Device Firmware.
This allows you to update each module with new firmware. New firmware will be designated by a REV number. Firmware updates will be available for down load in a special download section of the CandCNC website and on the Yahoo CandCNCSupport Forum.

The Hub Utility is an application provided to manage the C3BUS USB to RS485 4 Port Hub and the devices attached to it. With the utility you can:

Update the Hub Firmware (Firmware is the program that runs the hub)
Update Firmware in the Devises attached (like the DTHC IV)
Test basic communications
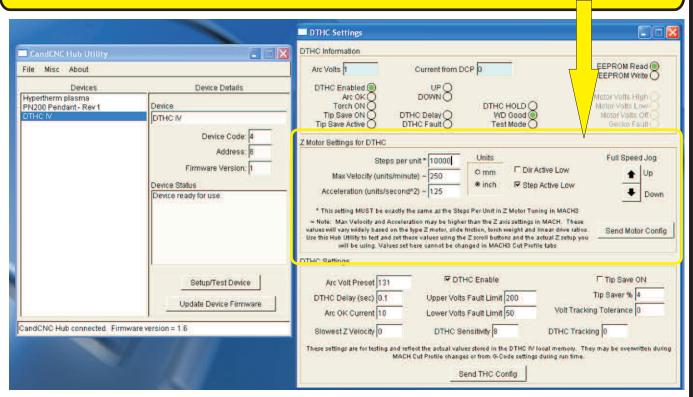Test device functions
Device level diagnostics
Set some device settings

What you CANNOT DO:

IMPORTANT!! This section covers some setup and testing of the DTHCIV module. While the DTHC IV Setup and Config Manual should be used to do the actaul DTHC IV part of the install you should do the minumum tuning listed to setup the Z motion

DTHC INFORMATION is direct feedback from the DTHC IV module and indicates the current status of the unit . You cannot make changes or do inputs from this section. Since you cannot run MACH and the Hub Utility at the same time these settings are primarily used for off-line diagnostics at the factory.

Z MOTOR SETTINGS. This section is the most important because it sets the base motor settings for the Z motor under DTHC control. You will find that the Max Velocity and Acceleration will be much higher than your settings in MACH for the Z motor tuning. This is normal because of the DTHC IV controlling the motion directly under THC. You should set this as high as possible. Move the settings up and test the Z motion using the Full Speed Jog buttons on the screen. The motor should move smoothly and rapidly both up and down. Lose steps (or faults on a servo system) back the numbers off by 25%. The settings here are for a stepper system with a 620 oz-in motor running a 5 TPI leadscrew. Your settings will vary but you should be able to hit about double the velocity and acceleration of the Z motor tuning in MACH. IT IS IMPORTANT THAT THESE SETTINGS BE OPTIMIZED for best response under DTHC control. They will effect the Gain and Tracking settings for the DTHC.

THIS IS THE ONLY PLACE TO SET THE Z TUNING FOR DTHC IV . A MINIMUM INSTALL REQUIRES YOU PREFORM THIS ONE FUNCTION IN THE HUB UTILITY.
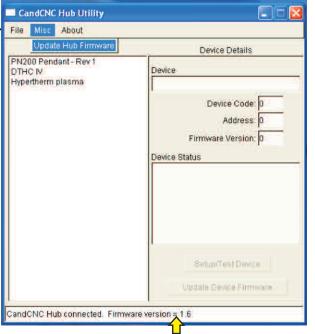
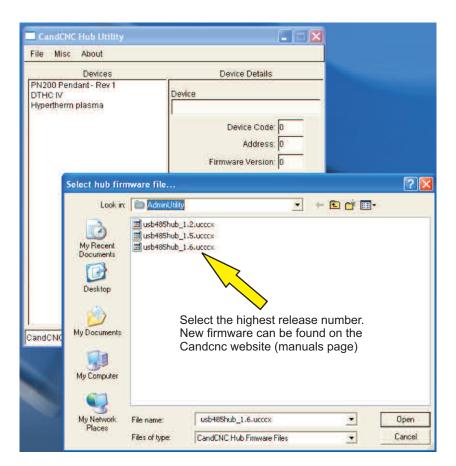**DTHC SETTINGS.** These settings are covered in the DTHC IV Setup and config Manual

MISC:

Opens choice to update firmware. This is the first step in updating the HUB FIRMWARE.

Only the devices you have purchased and have connected will show up in this List Box

Current Firmware Version

Select the highest release number. New firmware can be found on the Candcnc website (manuals page)
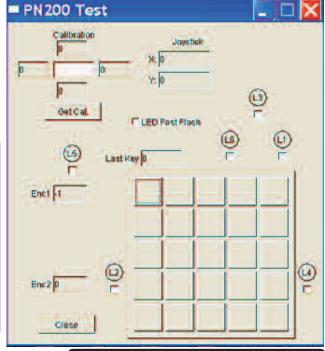
DEVICE TESTING: PN200 48 Function Hand Control

IF YOU DO NOT HAVE THE PN200 the device will not show up in your devices list and this screen will not appear.

Joystick shows XY position when stick on the PN200 is deflected. Confirms operation or joystick.

L1 - L5 (lamps) are indicators. You can click on the L numbers to turn on an indicator on the PN200 to test. Checking the box under it will cause it to flash. Multicolor LEDS will change colors if you click the L button again. LED Fast Flash changes.
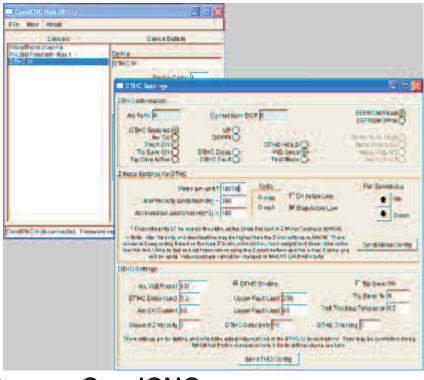
ROTARY ENCODER TEST
Enc1 (DTHC PRESET) encoder status. Rotating the encoder will increase the count clockwise and decrease counter clockwise.

Enc2 (FeedRate) Does the same.

5 X 5 keypad
reflects button pushes on the PN200 keyboard and displays key number in the Last Key DRO

IF YOU DO NOT HAVE THE HyT-Connect RS485 options the device will not show up in your devices list and this screen will not appear

BLADERUNNER AIO RIGHT SIDE VIEW
INPUTS FOR UBOB III AND EXPANSION OPTIONS

CLOSE UP VIEW UBOB MODULE
RIGHT SIDE
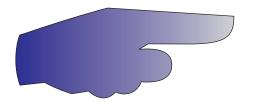
Connecting up the BladeRunner Control box. Take a look at the block diagram on th enext page, that gives an overview of the control box. Note that there are two cables that run from the **PC** and connect to the BladeRunner box. One is the (BLUE) Cat 5 from the C2Bus 4 Port Hub (not rewuired on ROUTER version) The other is the Ethernet CAT 5 (GREEN) and it is REQUIRED on all Ether-Cut systems
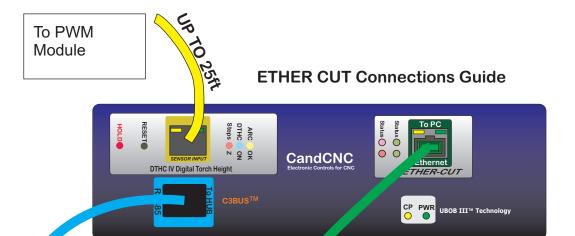
1. Install a Green CAT 5 drop cable (All pins straight through) between Ethernet (network) Port on the PC to the part marked Ethernet on the side of the BladeRunner controller unit.
2. If you have the DTHC IV model you should have the C3BUS USB to RS485 installed and working and the cable should be connected (BLUE CAT5)

Note all of the CAT 5 cables are the same pinout. We have designated and provided cables in the colors indicated to help prevent plugging in the wrong device to the BladeRunner.   **Getting the wrong device pluggin in and the unit powered up can result in possible damage to the module or the PORT on the C3BUS hub or the PC. BE CAREFUL**

To PWM Module

UP TO 25ft

ETHER CUT Connections Guide

HOLD | RESET | SENSOR INPUT | Steps Z | DTHC ON | ARC OK

DTHC IV Digital Torch Height

CandCNC
Electronic Controls for CNC

Status | Status

To PC

Ethernet
ETHER-CUT

RJ-85 | To HUB | C3BUS™

CP | PWR | UBOB III™ Technology

BLUE CAT5 cable for RS485 from C3BUS Jack on Ether-Cut to

UP TO 25ft

Green Cat5 from Ethernet Jack on Ether-Cut front panel TO Ethernet jack on PC. Up to 25ft length.

Ethernet Jack

CAUTION: All cables are CAT5 UTP 8 conductor and will plug into any CAT 5 (RJ45) jack. We have color coded the cables to help keep them from being mis-connected. If you use other CAT cables be sure to label them on each end. Connecting cables wrong could damage modules.

UP TO 25ft

CandCNC C3BUS RS485 4 Port Hub

PWR | Con ACT
USB

CandCNC
RS485 4 PORT HUB

ACTIVITY MONITOR

To Hypertherm RS485 PORT (ONLY) | C&C 1 | C&C 2 | PN200
1 | 2 | 3 | 4

USB PORTS

6 ft or less

HUB is REQUIRED for DTHC IV

CONTROLLER PC
RUNNING MACH3
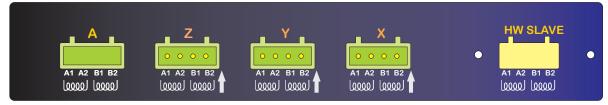
NOTE: For BladeRunner Servo system please see the end of the F section for the differences in the motor connections

A	Z	Y	X	HW SLAVE
A1 A2 B1 B2	A1 A2 B1 B2	A1 A2 B1 B2	A1 A2 B1 B2	A1 A2 B1 B2
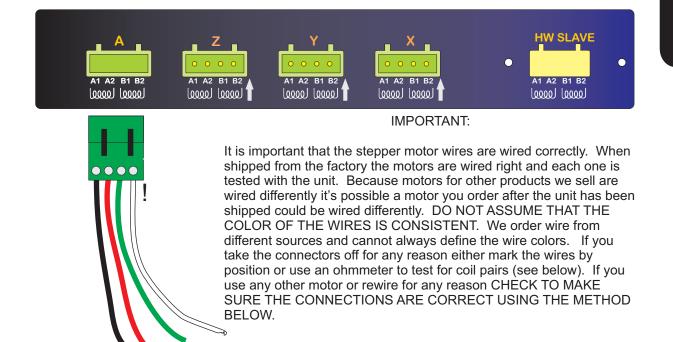
Screw Terminals Face UP

!

IMPORTANT:

It is important that the stepper motor wires are wired correctly. When shipped from the factory the motors are wired right and each one is tested with the unit. Because motors for other products we sell are wired differently it's possible a motor you order after the unit has been shipped could be wired differently. DO NOT ASSUME THAT THE COLOR OF THE WIRES IS CONSISTENT. We order wire from different sources and cannot always define the wire colors.   If you take the connectors off for any reason either mark the wires by position or use an ohmmeter to test for coil pairs (see Bladerunner Manual PartII Service Manual). If you use any other motor or rewire for any reason CHECK TO MAKE SURE THE COILS ARE

COLOR CODE MAY VARY

MOTOR SIDE
BladeRunner ESPII box
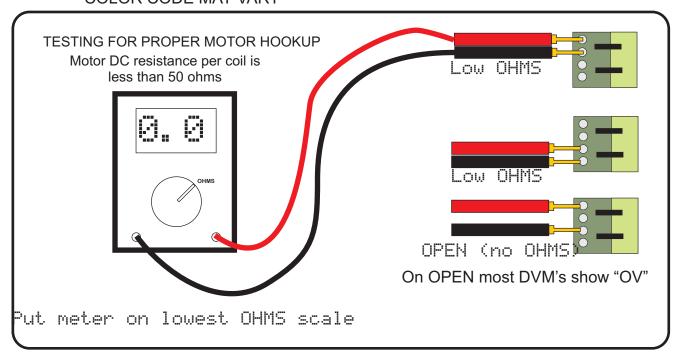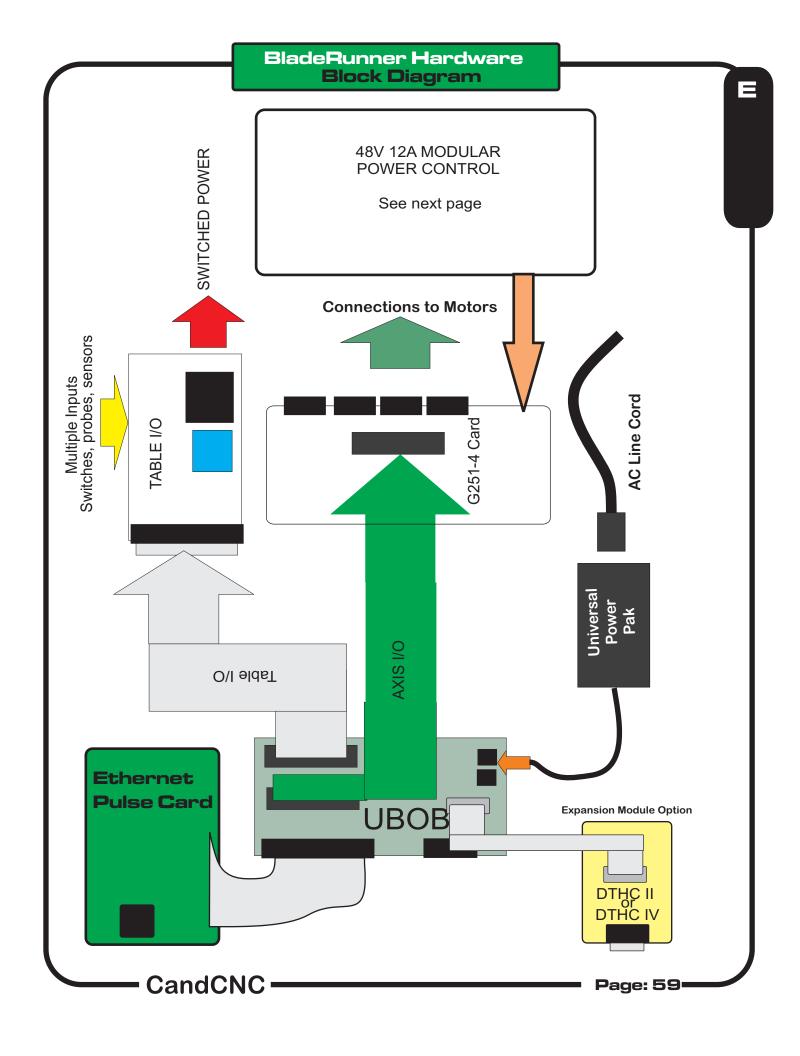
BLADERUNNER G251-4 MODULE FRONT PANEL FUNCTIONS

A	Z	Y	X	HW SLAVE
A1 A2 B1 B2	A1 A2 B1 B2	A1 A2 B1 B2	A1 A2 B1 B2	A1 A2 B1 B2

!

IMPORTANT:

It is important that the stepper motor wires are wired correctly. When shipped from the factory the motors are wired right and each one is tested with the unit. Because motors for other products we sell are wired differently it's possible a motor you order after the unit has been shipped could be wired differently. DO NOT ASSUME THAT THE COLOR OF THE WIRES IS CONSISTENT. We order wire from different sources and cannot always define the wire colors.   If you take the connectors off for any reason either mark the wires by position or use an ohmmeter to test for coil pairs (see below). If you use any other motor or rewire for any reason CHECK TO MAKE SURE THE CONNECTIONS ARE CORRECT USING THE METHOD BELOW.

COLOR CODE MAY VARY

TESTING FOR PROPER MOTOR HOOKUP

Motor DC resistance per coil is less than 50 ohms

0.0

OHMS

Low OHMS

Low OHMS

OPEN (no OHMS)

On OPEN most DVM's show "OV"

Put meter on lowest OHMS scale

48V 12A MODULAR
POWER CONTROL

See next page

SWITCHED POWER

Connections to Motors

Multiple Inputs
Switches, probes, sensors

TABLE I/O

AC Line Cord

G251-4 Card

Table I/O

AXIS I/O

Universal
Power
Pak

**Ethernet
Pulse Card**

UBOB

Expansion Module Option

DTHC II
or
DTHC IV

BladeRunner AIO Cover Removed Inside View

CrossFlow FAN OPTION

UBOB III Advanced Breakout Card

G251-4 Motor Driver

TABLE I/O CARD

DTHC EXPANSION MODULE OPTION

G251-SOLO 5th Axis OPTION

FAN-FUSE END PLATE

BLADERUNNER AIO FRONT PANEL
[Enhanced System Power II]
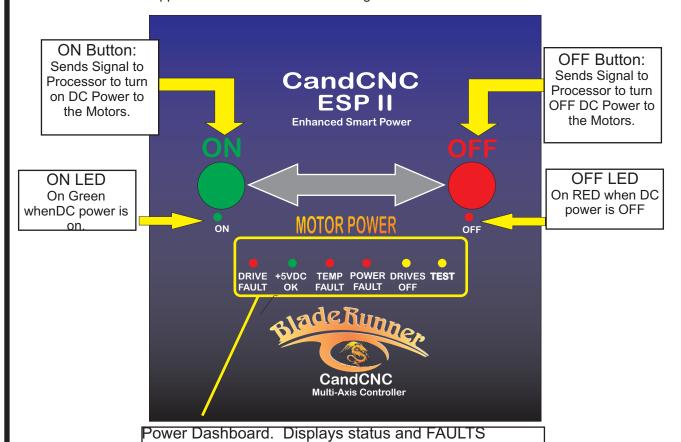
Located on the Front Cover of the ESPII Enclosure, the FRONT PANEL is the Operator Interface for the ESPII and provides tactile pushbuttons to turn the DC power to the Motors ON/OFF.   The FRONT PANEL is a SMART CONTROL utilizing a powerful microprocessor that monitors and controls the power section of the BladeRunner AIO. The ESPII monitors critical parameters, controls ON/OFF, and will automatically shutdown in microseconds in the event of a fault. The ESPII monitors/controls:

1. System DC status
2, System Driver Status (enable/disable drives)
3. DC voltage level (overvoltage shutdown)
4. DC current (load) level (overload shutdown)
5. Internal Temperature (overtemp shutdown)
6. System Fault Indicators (LED's and Screen Text)

Normal Power up sequence:
1. Operator turns on MAIN POWER SWITCH. +5VDC LED comes on; RED OFF LED comes on; DRIVES OFF LED comes on. All LEDS may sequence on once during processor turn on.
2. Operator pushes ON Button. ON LED turns Green OFF LED goes off. Power comes up on DC bus. Approx 2 sec later Drives OFF LED goes off and MOTORS LOCK

ON Button:
Sends Signal to Processor to turn on DC Power to the Motors.

OFF Button:
Sends Signal to Processor to turn OFF DC Power to the Motors.

CandCNC
ESP II
Enhanced Smart Power

ON

OFF

ON LED
On Green whenDC power is on.

OFF LED
On RED when DC power is OFF

ON

MOTOR POWER

OFF

DRIVE FAULT	+5VDC OK	TEMP FAULT	POWER FAULT	DRIVES OFF	TEST

BladeRunner
CandCNC
Multi-Axis Controller

Power Dashboard. Displays status and FAULTS
See Chart on next page to decode FRONT PANEL indicators

IMPORTANT INFORMATION: The ESPII provides multiple levels of protection for the system and the motor drivers. Electronic fusing will shutdown power in milliseconds as opposed to conventional fuses. The Primary AC has two levels of control. The MAIN POWER SWITCH and the in-line SAFETY RELAY (controlled by the FRONT PANEL. The Safety RELAY controls AC power to the DC power supply section. Besides Electronic fusing the system also provides failsafe conventional fuses/breakers. There are two levels of conventional fusing on the DC power side. The locations and values of the conventional fuses are in the ESPII service Manual.
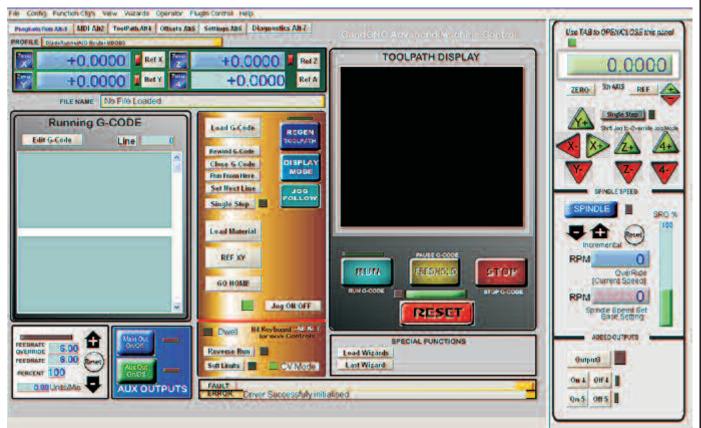
FRONT PANEL LED LEGEND

Note: LED!s flash several times on intial power up. Pushing recessed TEST button will test all LED!s and show common patterns for comparison

INDICATOR	Color	STATE	MEANING	NOTES
DRIVE FAULT	RED	1 flash /pause	X Drive Fault	A Drive Fault indicates a shorted motor/cable or a failed Motor Driver.
DRIVE	RED	2 flash /pause	Y Drive Fault	
DRIVE	RED	3 flash /pause	Z Drive Fault	
DRIVE	RED	4 flash /pause	A Drive Fault	
DRIVE	RED	5 flash /pause	5th Drive Fault	May indicate misconfigured Slave Axis Setup
+5 VDC OK	GRN	ON Steady	+5 is ON/OK	Shows power on and logic supply OK
TEMP FAULT	RED	1 flash /pause	Case Temp Fault	Internal Case Temp is too high. Check fans and filters
POWER FAULT	RED	Fast Flash	Power Overload **DC POWER**	Too Much Current drawn Auto Shutdown. Overload of power Module(s)
POWER FAULT	RED	Slow Flash	Over Voltage	DC Volts Exceed max for safe operation. Line surge or back EMF. Auto Shutdown
DRIVES OFF	YEL	ON Steady	Drives Disabled	Only on BladeRunner. Shows drives are freewheeling (disabled). Normal condition during.power up and faults/shutdown
TEST	YEL	ON Steady	Test Mode	Unit is in self test
TEST	YEL	Flashing	Config Error	MODE Configuration error or unplugged module.

Load and Testing MACH

After you have installed MACH and run the BladeRunner INSTALL on the Support CD, open MACH3 using either the MACH Loader and the BladeRunner selection from the list OR using the BladeRunner Icon created in the desktop.
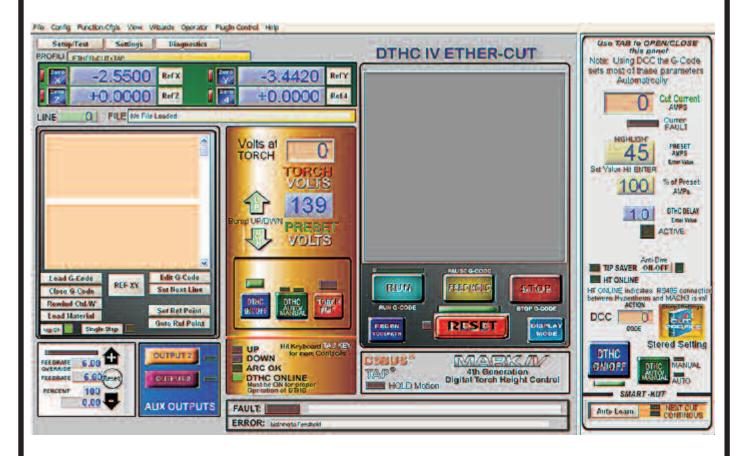
You should see the following screen or something very close. If you are missing the Desktop icon or it's not in the selection list, re-run, the INSTALL again. If you have the Profile (BladeRunner) listed in the MACH LOADER and the screen does not display, go to the top menu bar and select **VIEW/Load Screens** and navigate to the MACH3 folder and select BladeRunner-Router.set. If it is missing any of the Bitmaps (picture buttons and/or backgrounds) then confirm the Installer created the CandCNC folder under the MACH3/Bitmaps Folder and there are files in that folder. We have included a Zip file on the CD of all the bitmaps and the ZIP file is on the CandCNCSupport Forum site in the FILES/BladeRunner Support Files Folder. You can UNZIP the files in the Bitmaps.ZIP file directly to the MACH3/Bitmaps/CandCNC folder. Along with bitmaps and other features the BladeRunner screens contain several custom functions embedded as code behind certain buttons. If you elect to use another screen SET file with the BladeRunner be aware some functions will not work**. The DTHC screens have specific functions and the DTHC functions will not work on other screen sets.**

Typical Router Screen with TAB Flyout

TAB OPTIONS

CUSTOM CandCNC Screen SET provided with BladeRunnerAIO UBOB3 Profile from the Master Installer file. Some features may change over time. DTHCII specific functions are covered in detail in the DTHCII User Manual Added controls can be accessed with TAB (flyout)

BladeRunner DTHC IV
PLASMA PROFILE SCREEN

Screen Sections e[...]

MACH3 TOP MENU. POPS up windows on top of the screen to access various settings. Three most used are: 1. Files 2. Config 3 View. This menu row is visible and can be accessed from all screens

MENU SCREEN SELECTION. Consists of tabs to select different screens. In normal run mode the PROGRAM RUN screen is the most used. The DIAGNOSTICS screen is used to confirm proper settings and functions and will be covered later

Mach3 CNC Controller

File Config Function Cfg's View Wizards Operator PlugIn Control Help

Program Run | MDI | ToolPath | Settings | Offsets | Diagnostics

BladeRunnerAIO-DTHC-UBOB3

Zero X +0.0000 Ref X   Zero Y +0.0000 Ref Y

Zero Z +0.0000 Ref Z   Zero 4 +0.0000 Ref 4

Line 0   No File Loaded.

DRO (Digital Readouts) for axis position and for manual referencing and zeroing the DRO's REF buttons move an axis towards an associated HOME switch. When the axis hits the switch It will stop and backup slightly. If it moves the wrong way or does not move at all see the section on **CONFIG/HOMING & LIMITS**

Current G-Code File Loaded or running

RUNNING PROFILE Box Shows the current MACH PROFILE you have running.

Loaded/Running G-code screen shows g-code as it is executed. Stopped code can be scrolled and new start points selected. The code can be Edited using the Edit G-Code Button
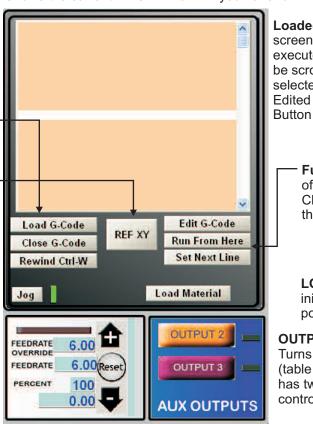
Function Buttons allow control of the G-code, Loading and Closing G-code and a rewind to the start button

REF XY Button, performs a REF move on XY at the same time but not on Z. Useful on plasma after the first REF has been done to locate 0.0

JOG ENABLE Button Turns keyboard jog on/off (should stay on normally)

FRO Feedrate Override changes feedrate on all Axis at the same time

Load G-Code | REF XY | Edit G-Code
Close G-Code | | Run From Here
Rewind Ctrl-W | | Set Next Line

Jog   Load Material

FEEDRATE OVERRIDE 6.00
FEEDRATE 6.00 Reset
PERCENT 100
0.00

OUTPUT 2
OUTPUT 3
AUX OUTPUTS

Function Buttons allow control of the G-code, Loading and Closing G-code and a rewind to the start button

LOAD MATERIAL button initiates a move to a preset postion

OUTPUTS ON/OFF Buttons Turns on/off the two AUX relays (table i/o Card). Bladerunner AIO has two wired AC sockets that are controlled from these buttons

DTHCII SCREEN SECTION.

A detailed breakdown of all the buttons functions and readouts on the DTHCII section are covered in the DTHCII User Manual (separate manual) Only general descriptions are covered here.

UP/DWN and Send to DTHC Button. Any value typed into the PRESET VOLTS and ENTER is used to lock the value inthe DRO is instantly transferred to the DTHCII memory when the Send to DTHC button is hit. The User/operator can quickly change the PRESET VOLTS before or DURING a cut and change the ARC GAP in the process

TORCH AMPS Displays the action Cutting AMPS IF the CandCNC DCP01 Digital Current Probe has been installed. Otherwise it reads zero. IT IS NOT USED FOR THE CUT CURRENT PRESET value.

THC ON/OFF turns the THC function In MACH ON or off. The DTHCII can turn this on automatically when the torch fires (setting in the Cut Profile) Operator can turn the THC on/off manually. When THC is off MACH ignores any commands from the DTHCII to move the Z

TORCH ON/OFF toggles the torch (OUTPUT1) on/off manually from the screen. The torch can be turned on or off at any time MACH is out of RESET....even during a run

STORED SETTINGS (CUT PROFILES). This button opens a window that displays a range of values and settings for the DTHC to use. The initial display is of the CURRENT SETTINGS in the DTHCII memory. Profiles by material can be recalled. selected and added. Detailed use of the CUT PROFILES is covered in the DTHCII User Manual

INDICATOR LED's

TIP SAVER (turns on when TIP saver is active. TIP SAVER is a dynamic anti-dive that keeps the torch from diving on corners or when crossing a void or existing kerf

UP/DOWN/ARC OK shows the statues of those inputs from the DTHCII. These are the COMMANDS from the DTHCII to MACH.

DTHC ONLINE shows the communication status of the DTHCII module to MACH3. It MUST be on to allow MACH to display screen values and to allow Cut Profiles to transfer to the DTHCII

IMPORTANT: There are Self-Tests that can be preformed on the DTHCII modules and other modules in the setup. They establish that the modules are functional and sending data to both the parallel port inputs and the PC serial input. If you do not have proper display of values while cutting or the DTHC ONLINE is not ON you are missing critical signals. See the DTHCII User Manual to run the tests

FEEDHOLD Pauses G-Code at end of buffer. Leaves outputs active

STOP Stops G-code execution instantly (dumps buffer) Turns off ouputs

RUN (Cycle Start) runs g-code that is loaded . Will restart g-code if in PAUSE or STOP

NOTE: To stop gracefully (no lost position) use the FEEDHOLD and after machine motion has ceased use the STOP.

RESET (Toggle ON/OFF) Stops all code, Turns off all ouputs, Stops any macro. Turns off Charge Pump Toggle turns
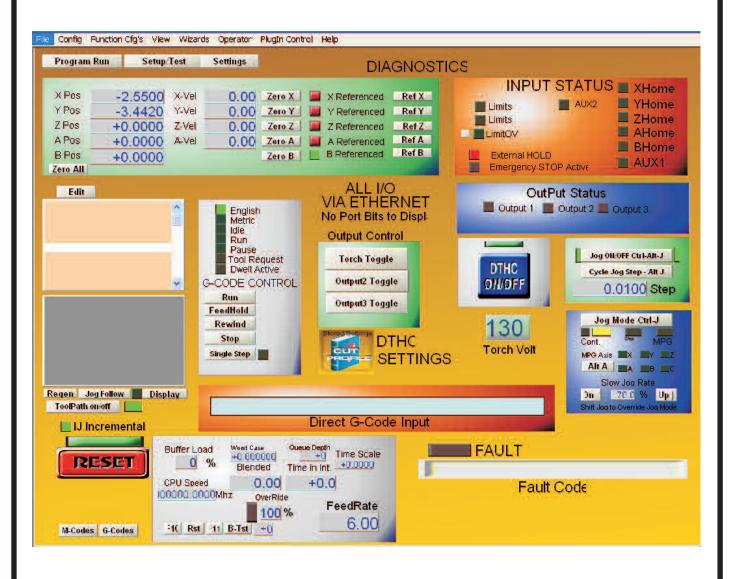
FAULT Displays ESPII and CandCNC specific faults here
ERROR Displays MACH based ERRORS here

FAULT - ERROR Message box. Scrolls FAULT messages from CandCNC ESPII and other "smart" devices. Shows drive faults, Power Faults and Hypertherm Fault messages for units equipted with otions RS485 port and optional HyT-Connect RS485 SIM Kit.

ERROR messages are information and critical messages from the MACH system.

Diagnostics Tab

Used to test and diagnose general Input and output problems and to do test runs.
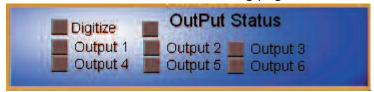
AXIS CONTROL Diagnostics: Has the same DRO's the same Axis ZERO buttons and manual REF buttons as the Program Run Screen so the User can see the numbers without have to flip back and forth.   When troubleshooting you can see activity on an axis and do setup if needed.

INPUT STATUS BOX: Shows the Inputs as they are mapped in MACH.   The Inputs are YELLOW when ON (active). The inputs should all be OFF (grey) when the system is first turned on and MACH is out of RESET. There MAY be an Emergency (E-STOP) on if the DC power to the motors is off on the BladeRunner. The Limits will seldom light because as soon as a LIMIT goes active, to puts MACH in RESET and the INPUTS are no longer displayed correctly. It turns the LIMITS OFF as soon as the LIMIT goes active. The indication a LIMIT is working is if when hit it puts MACH into RESET. The setup or HOMEs and LIMITS will be covered in later in this manual. Use the INPUT Status to test the individual inputs. Please note that Inputs FIRST hit specific pins on the parallel port and the MACH PROFILE determines what each one does so if you have inputs that are not correct the first thing to check is the RAW PAORT INPUT BITS on the following pages.

OUTPUT STATUS: Displays the status of the OUTPUTS/ Active outputs FLASH RED (not on steady) It uses the mappings in MACH to activate a specific out NAME. The physical output that is matched to is set in the PROFILE (Ports&Pins/Ouput Signals) When you activate an output like the TORCH Output or Outputs 1 and 2 you should see them start and flash in the OUTPUT STATUS BOX.   It does not mean the actual output signal name is active only that the signal is active and if mapped properly should activate the specific output on the BladeRunner. See the section on setting the OUTPUTS

OUTPUT Status (Cont).   There are two AUXILLARY OUTPUT Relays on a BladeRunner AIO unit. They are designed as Output 1 and Output 2 on the Buttons and they toggle ON/OFF the AC Outlets A and B on the end of the BladeRunner Box. These AC outlets are wired to the AUX AC line cord on the BladeRunner. That cord must be plugged in before the outlets can be used. CAUTION there is high voltage (120VAC) at the Relays and the Outlets. DO NOT OPERATE THE BLADERUNNER WITH THE AUX AC CORD PLUGGED IN AND THE TOP COVER REMOVED.

NOTE: The number of output relays can be expanded by adding in a Quad Relay Expansion card but is seldom used so connections and setup are not covered here

On a BladeRunner Dragon-Cut (with DTHC) OUTPUT 1 in MACH is used to turn on the TORCH Relay located out in the THC SENSOR PWM. Operation is covered in depth in the DTHCII User Manual but it is easy to simply plug in the THC SENSOR PWM module to the DTHCII module using the 25ft UTP Cable and test the TORCH ON by toggling the TORCH button on the Diagnostics Screen and watching the TORCH LED on the front of the THC SENSOR PWM module. You can test the other two AUX outputs by plugging in the AUX AC cable and plugging in an AC load (table lamp, 120VAC FAN . etc) and toggling the individual outputs on and off.

The AUX outlets can also be turned ON and OFF from G-code using an "M" command. What M command is used to turn on/off an OUTPUT is a setting in MACH and comes defaulted so a M03 or M04 turns on OUTPUT1 (Torch on the Plasma Profile, Spindle on the Router Profile.) M05 turns OFF either.   In a full Spindle Speed System the M04 turns ON the REVERSE RELAY.

The two AUX Relays (See Setting Outputs Section) are located on the TABLE I/O.
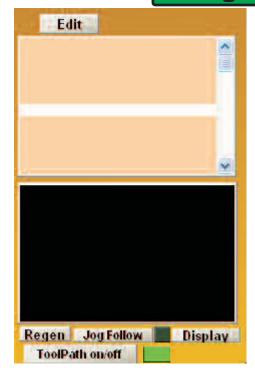
Control OUTPUTS from DIAGNOSTICS SCREEN via the Toggle Buttons for each output,
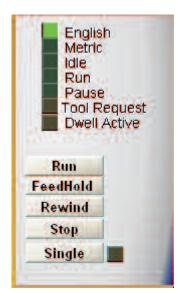
NOTE: Only 3 Outputs are availaible on a BladeRunner AIO Dragon-Cut (Large buttons above). The Router setup only has 2 outputs available.

Diagnostics Screen allows you to LOAD and RUN G-CODE files and to see the scrolling G-CODE.   To load a G-Code file move to the top tool bar and FILES/Load GCode and select the file to load. It will appear in the G-Code window. There is a small Toolpath display under the G-CODE window and the dispaly can be turned ON/OFF with the buttons under it.

To RUN, Feedhold, STOP, Rewind of SINGLE STEP from the Diagnostics Screen use the Buttons shown.

There are status LED's for UNITS and to show running status and Dwell.

USING SINGLE STEP TO TROUBLESHOOT CODE:
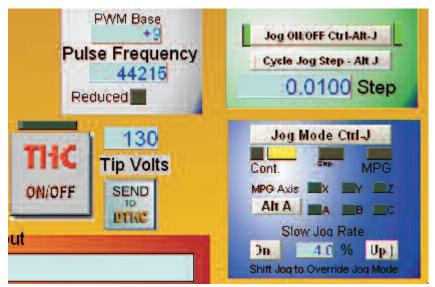
Often a mistake in G-Code or the setup is hard to spot because it runs faster than you can watch the machine and the code execute. The SINGLE STEP can help with that. It puts MACH in "Single Block mode" which means it will execute ONE LINE (block) of G-Code at a time. It does this by clicking the RUN button each time you want the next line of code to execute. On a plasma we recommend you turnoff the plasma and disable the AUTO THC ON (Cut Profile) before using the SINGLE button. With the SINGLE Button on (LED ON) you can run a line, watch the moves, take a measurement if needed and see if the motion is correct.

Other things you can control from the Diagnostics Screen:
1. JOG ON/OFF (unusually left ON)
2. Set the SINGLE STEP Jog Increment (Cycle Jog Step)
3, Change the JOG MODE from CONTINIOUS to STEP.   STEP MODE only
moves the axis the JOG INCREMENT each time you hit the Jog button.
4. Change the SLOW JOG rate (no SHIFT with a JOG KEY = Slow jog).
You can use the UP DOWN buttons or type in the value in the DRO (hit
enter to "SET" the value)
5. Turn the THC Logic in MACH ON/OFF
6. Enter a new TIP VOLTS (PRESET VOLTS) value [Enter Key to Set] and
then SEND to DTHC (change the running value in the current DTHC
configurations

While most of the controls are on the Program Run Screen of MACH the
DIAGNOSTICS SCREEN lets you monitor inputs/outputs and position while
running manually or via code. While there is a lot of information and buttons it
offers the feedback you need when doing the intital setup or troubleshooting of
a system. Earlier in the PC Hardware Section you see how the RAW PORT
INPUT BITS shows if the Parallel Port is properly configured and respondiing.

Setting up the Software Slaved Axis. BladeRunner 300-4 and 620-4 are shipped with 4 motors but **the A axis is NOT SLAVED in the default setup**. You will need to decide the axis naming convention you will be using for X & Y. There are several schools of thought here. The old convention is to call the "long" axis X and the short axis "Y". This can make for some confusion as to how to layout files to be cut if the operator station is not facing perpendicular to the long axis. Our approach has always been to use the computer screen layout where the vertical (UP and Down) on the screen is Y and the horizontal on the screen (side to side) is X. That is the way the software will want to designate the axis on the computer by default. In the following pages we show typical setups and operator position. The goal is to have the toolpath oriented the same way as it shows on the computer drawing in relation to where the operator stands at the table. The recommend placement of HOMES is based on the fact that normally the lower left corner of the drawing is defined as the 0, 0 (origin) of the drawing and the resulting G-code from the CAM if it follows the same convention.

- NOTE: IF YOU HAVE A 4 MOTOR SYSTEM, the A axis should be software slaved to the axis you have designed as the Gantry motion axis (X or Y). We do not have that setting as a default because we do not know which axis you will designate as the gantry motion axis.
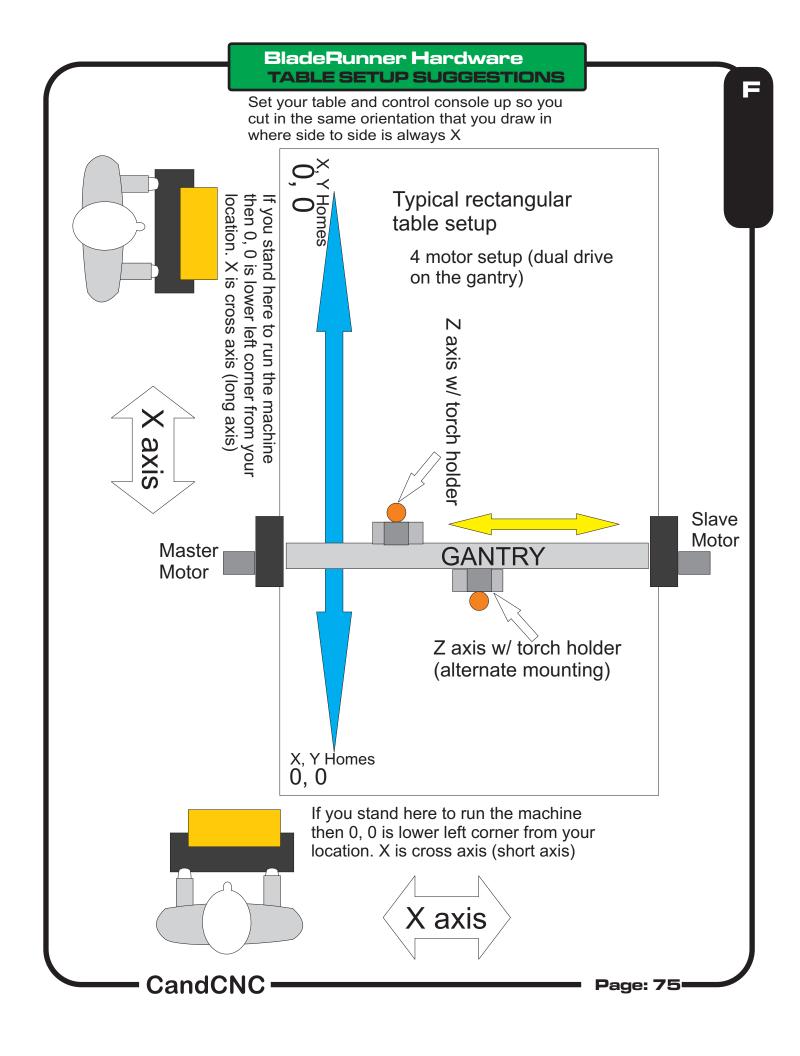
To slave the axis in software: Open MACH3 CONFIG/AXIS SLAVING

Select the Axis you wish to slave the A to (X or Y and click the A radio button on that axis.

If you have a 5 motor Ether-Cut system. The 5th axis is set by default to be controlled as a full 5th independent (B axis). Earlier Bladerunners with the parallel port could only directly control 4 axis and the 5th axis had to be HARDWARE slaved usign the jumpers on the UBOB. It is recommended that you use A axis software slaved to either X or Y. You then leave the settings in the Ether Cut Motor Ouputs mapped to have B as the fifth axis. This will then correspond to the rotary posts for our system.

Set your table and control console up so you cut in the same orientation that you draw in where side to side is always X

X, Y Homes
0, 0

If you stand here to run the machine then 0, 0 is lower left corner from your location. X is cross axis (long axis)

X axis

Typical rectangular table setup

4 motor setup (dual drive on the gantry)

Z axis w/ torch holder

Master Motor

GANTRY

Slave Motor

Z axis w/ torch holder (alternate mounting)

X, Y Homes
0, 0

If you stand here to run the machine then 0, 0 is lower left corner from your location. X is cross axis (short axis)

X axis

NOTE: All Bladeruner DTHC IV and BladeRunner Ether-Cut systems are shipped with the UBOB III REV 15 card shown on the next two pages. The default settings as shown are done prior to final testing and should not be changed .

IMPORTANT: REG1 tab MUST be mounted tightly against the aluminum subplate. The ESS uses a lot more 5V power and this regulator gets HOT! and will shutdown if not on a good heatsink.

+5 out to Ethernet pulse card

Not Used

NOT USED
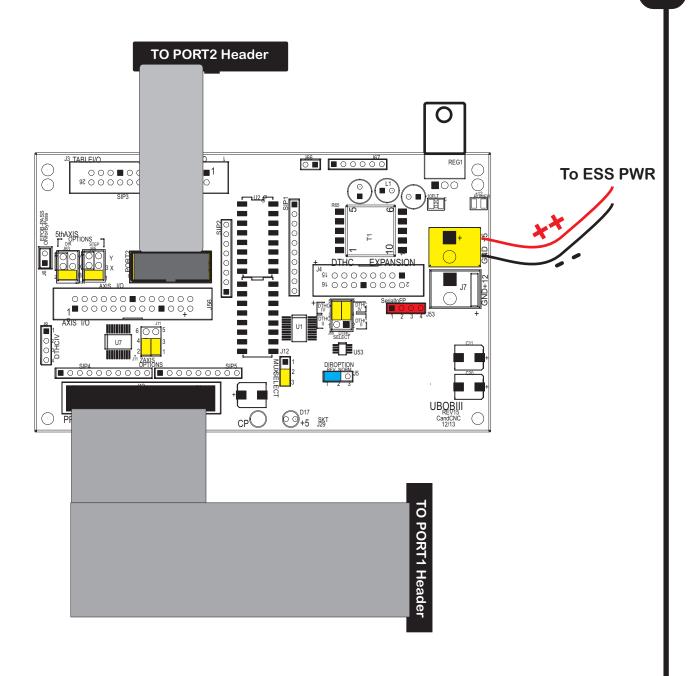
DTHC IV Ethernet Port. 10 pin header to ESS via special ribbon cable Provides Independant 5th axis (B) with J63 and J65 set as shown.

Connections on UBOB III REV 15 to ESS Ethernet Card
Other standard connections not shown

TO PORT2 Header

To ESS PWR

J3 TABLE I/O

J66   J67

REG1

SIP3

++

U2

SIP1

SIP2

R65

L1

10FLT

J22

J14
B2S/ER

EPOB-PASS
ON for ByPass

5thAXIS
OPTIONS

DIR   STEP
J63   J65

J6

Y
B X

T1

GND-15

+

DTHC   EXPANSION

AXIS I/O

J4

J56

SerialtoFP

GND+12

J7

+

1   2 3 4 J53

AXIS I/O

J8

U1

DTHC
IV

DTHC
IV

DTHC
II

DTHC
II

DTHCIV

U7

J11

J68 DTHC
SELECT

C11

ZAXIS
OPTIONS

J12

U53

C20

SIP4

J11

SIP5

DIROPTION
REV NORM

J5

1   2   3

MUXSELECT

UBOBIII
REV15
CandCNC
12/13

PR

CP

D17

+5

SKT
J29

TO PORT1 Header

Inputs

Signal	PORT-PIN	25Pin CON TABLEI/O	TABLE-IO NAME	OLD SIGNAL
XHOME	1-11	14	XHOME	XHOME
YHOME	1-12	15	YHOME	YHOME
ZHOME	1-13	16	ZHOME	ZHOME
AHOME	1-15	17	AHOME	AHOME
BHOME	2-4	21	BHOME	THCUP
CHOME	2-5	24		THC DOWN
INPUT1 (HOLD)	2-3	2	CHOME	ARCOK
LIMITS	2-2	1	LIMITS	LIMITS
ESTOP	1-10	20	EPO	EPO
AUX1	2-15	23		NC
AUX2				
AUX3				
AUX4				
AUX5				
AUX6				

OUTPUTS
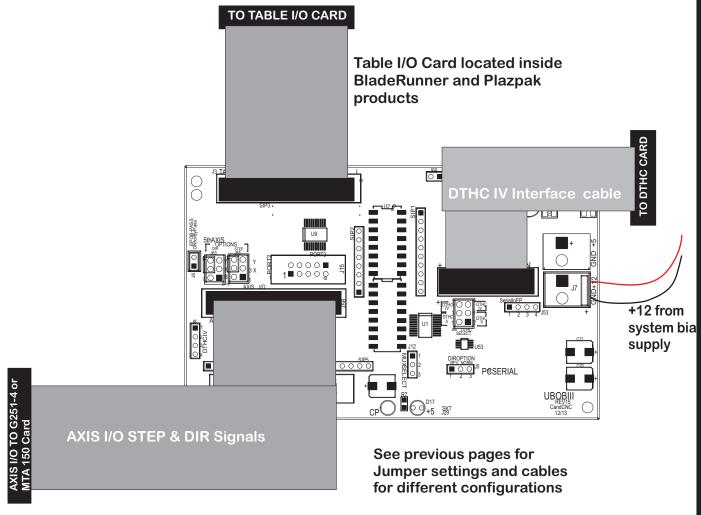
Signal	PORT-PIN	25Pin CON AXIS I/O	TABLE-IO NAME
XSTEP	1-2	AxisIO-2	
XDIR	1-3	AxisIO-3	
YSTEP	1-4	AxisIO-4	
YDIR	1-5	AxisIO-5	
ZSTEP	1-6	AxisIO-6	
ZDIR	1-7	AxisIO-7	
ASTEP	1-8	AxisIO-8	
ADIR	1-9	AxisIO-9	
BSTEP	2-14	AxisIO-18	
BDIR	2-16	AxisIO-19	
CSTEP	2-1	AxisIO-24	
CDIR	2-17	AxisIO-25	
OUT1=TORCH RELAY	1-14	NA	
OUT2	1-1	10	K4 RELAY
OUT3	1-16	11	K3 RELAY
Charge Pump	1-17		

UBOB III REV 15 Standard Cables used on ALL configurations

TO TABLE I/O CARD

Table I/O Card located inside BladeRunner and Plazpak products

TO DTHC CARD

DTHC IV Interface cable

J3 TA
I66
SIP3
SIP1
EPOB PASS
ON/onBy Pass
U2
SIP2
U9
5thAXIS
OPTIONS
DIR   STEP
J63   J65
PORT2
Y
X
+5
GND
+
J15
PORT2
AXIS I/O
1
J56
N
J7
GND+12
+
DTHC
IV
DTHC
IV
SerialtoFP
1   2   3   4
J53
DTHCIV
U1
DTHC
DTHC
J9   DTHC
SELECT
+12 from system bias supply
J12
1
2
3
MUXSELECT
U53
DIROPTION
REV NORM
1   2   3
J5
PC SERIAL
C11
C20
SIP5

AXIS I/O STEP & DIR Signals

AXIS I/O TO G251-4 or MTA 150 Card

R7
CP
D17
+5
SKT
J29
UBOBIII
REV15
CandCNC
12/13

See previous pages for Jumper settings and cables for different configurations

On MP3100 and MP3500 systems the Axis I/O ties to the MTA150 card either internally or via a DB25 cable connection depending on the model
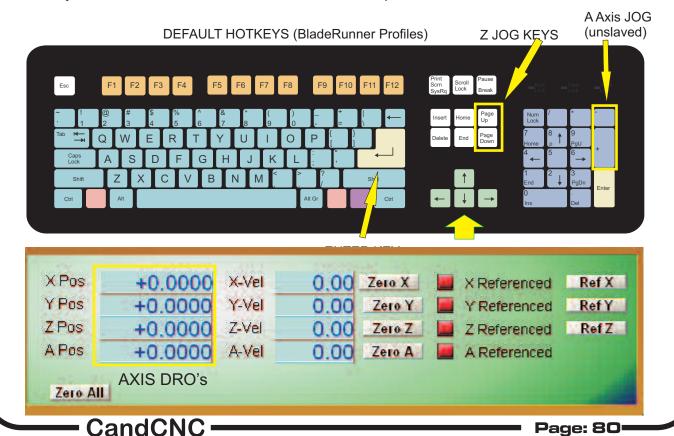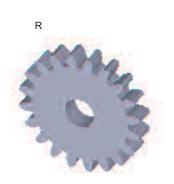
INITIAL MOTION CHECK:
After you have powered up the BladeRunner and checked the power on sequence and checked the motors on each axis the next step is to plugin all motors and run an intial motion check.   You can wait to do this after you get the motors mounted on your CNC table if you want or you can set the motors on the table oriented like they will be mounted to check inital motion and direction.
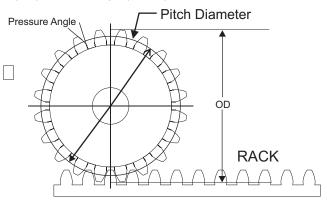
1. Make sure the PC connections have been made and the PC Hardware ports setup as per previous sections.
2. Plug in all the motors. Orient them like they are going to be mounted. Label them if they are not on the table.
3. Turn on the main power switch on the end of the BladeRunner ESPII box.
4. Turn on Motor DC using the Front Panel ON (White) button.
5. Check to make sure the motors "lock" and that you have a Green ON LED
6. Start MACH3 with the plasma or router profile (desktop Icon).
7. Switch to the DIAGNOSTICS TAB in MACH
7. Jog the axis in turn using the keyboard Jog keys
      a. Left and Right Arrow --> and <-- should jog X axis
      b. Up and Down Arrow should jog Y axis
      c. PageUP and PageDown should Jog Z axis
8. STOP! If you cannot get an axis to move or or it only moves in one direction:
      a. Check to make sure the associated DRO is changing on the screen
      b. If it is then check all of your cables from the parallel port
      c. If you have DRO action and still fail to get motion in both directions, turn to the Service Manual Section. See the section on troubleshooting port problems.
9. If you have motion on all attached motors then proceed to the next section

A Axis JOG (unslaved)

DEFAULT HOTKEYS (BladeRunner Profiles)   Z JOG KEYS

AXIS DRO's

LINEAR MOTION WITH RACK & PINION

Pressure Angle

Pitch Diameter

R

OD

RACK

TYPICAL SPUR (PINION) gears
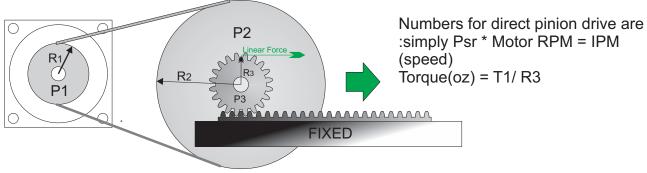
Psr =   Pinion Speed increase ratio = Pitch Dia [in inches] * PI (3.1416)/1
                                                    = Pitch Dia [in mm] * PI (3.1416)/25.4

Example: 1" Pitch Dia pinion will have a step up ratio (speed increase of 3.14 (approx 3)

Belt reduction decreases speed by Raw Speed /Belt Reduction Ratio
Belt reduction increases linear force by normal force X Belt Reduction Ratio

Raw Motor Resolution = 1/200 = .005" linear [.127mm]
Final linear resolution = .005/Belt Reduction Ratio

Belt Reduction Ratio =
R2/R1

P2

Linear Force

R1

R2

R3

P1

P3

FIXED

Numbers for direct pinion drive are :simply Psr * Motor RPM = IPM (speed)
Torque(oz) = T1/ R3

Forces:
T1= Rated motor holding torque (Oz-in) / R1
T2 = Shaft holding torque of P2 = motor holding torque * Belt Reduction Ratio
T3 = Torque(oz-in at pinion (teeth) = T2 * R3

Note: Motor torque decreases with Motor RPM so a number of about 50% of the holding torque

Motor constants: (based on stepper motors provided by CandCNC)
Typical RPM of hybrid steppers (moderate load) with different DC power
                24 VDC = 300 RPM
                48 VDC = 600 RPM
                65 VDC = 800 RPM
Number of steps for 1 motor REV = 2000 (this a fixed number based on Microstepping X10)

EXAMPLES

620 oz-in Stepper motor @ 48 VDC with 1" dia pinion gear & direct drive:
Max possible IPM = 600rpm X 3.142 = 1885 IPM

* 50% RPM linear force = 50% Stepper motor torque / pinion Radius/ Pinion Speed Ratio = (310Oz-in/.5in) / 3 = 206.66 linear oz of force

Same design but with 3:1 belt reduction from motor to pinion shaft:

(310OZ-in/.5in)/1 = 620 linear oz linear force.

* in the above calculations the motor RPM and torque numbers of 50% were used to operate the motor in the center part of it's torque-RPM curve.

Calculating the beginning Steps per UNit on an AXIS

Use the following formala to get a ballpark steps per unit number in MACH

Psr =   Pinion Speed increase ratio = Pitch Dia [in inches] * PI (3.1416)/1

Target Steps per Unit = (Psr X 2000)/Belt Reduction ratio

This will give you the required number of steps it takes to move 1"

Once you have the calcualted number of steps it takes to move the axis one inch then put that number into the STEPS per UNIT of the motor.

Based on the speed numbers you have calculated from the previous pages set you velocity to a vlaue of 60 to 80% of that number.

Set your Beginning Acceleartion to a low number like 10

To fine tune the calibration see the next pages.

Setting the initial Steps per Unit in MACH3 motor tuning.
Every table will have different Steps Per Unit, Velocity (max speed) and Acceleration settings. To do testing on the table you must determine the correct settings for your table. Use the following method:
For Steppers:
1. Determine the number of steps your motors need to make one full revolution (Normally 200 for most steppers)
2. Multiply by the Motor Driver microstepping rate (10 for BladeRunner/Gecko drivers) = 2000 steps for one motor revolution.
3. Determine the drive ratio of your mechanical drive (how far does the leadscrew or pinion move the load with one revolution of the motor).
4. Convert everything to you Units (inches/millimeters) and same time measurements (seconds or minutes)**.**

Using 1 and 2 above we know we have to send 2000 pulses (step pulses) from MACH to rotate the motor **one complete revolution** (360 Degs).

 The rest of the math is based on the transmisson ratio(s) between the motor and the final drive element. If it's Rack & Pinion you need to know the DP (diametric pitch) or the tooth count of the pinion gear and the TPU of the Rack (Teeth per unit)
If it's a direct drive leadscrew you need to know the treads per unit (TPI for inch units)

We have to determine how far the load moves (in units) for each REV of the motor.

Lets do a direct drive leadscrew of 5 TPI :

It takes 5 turns to move the load one inch of linear movement so the steps per inch (unit) of the axis is simple: 2000 [number of steps for one rev] X 5 [number of Rev to move one inch] = 10.000 steps per inch. (.0001") resolution. About 6 to 7 times the torque. 1/5th the motor Speed.

Now let's do a R & P direct drive and an R & P with a belt reduction transmisson:

For a R & P the distance traveled per rev of the pinion is given by the DP of the pinion X PI [3.1416]. Ifwe use a 1" DP pinion the distance traveled is 3.1416" per rev of the pinion   So a direct coupled motor gives us over 3" of travel per rev. To get it back to a Unit (1 ") it would be the number of steps (2000 from above) / 3.1416 or 636.6183….as you can see, the resolution at .00157 per step is MUCH courser than the 5 TPI leadscrew. The max velocity (speed would be over 8 times the leadscrew but with 1/3 the torque of the motor specs) is over 2000 IPM.

To gain back the lost resolution and torque you should belt reduce between the motor and pinion. With a 5:1 ratio you would see the numbers change to:

2000 /3.14165 X 5 or 3183.1 steps per inch (.000314 inch). Torque would be 1.66 times greater than motor rated torque.

NOTE: DO NOT use the microstepping in a "true" resolution calculation for *accuracy*. Microstepping is for motion smoothness and cannot be counted on to actually position the motor shaft at a fraction of a motor pole (between poles). It can be off and the faster the motor spins the less effect microstepping has. The only true resolution will be the 200 steps per rev of the motor. In practice it will be somewhat better especially at slower RPM but it varies.
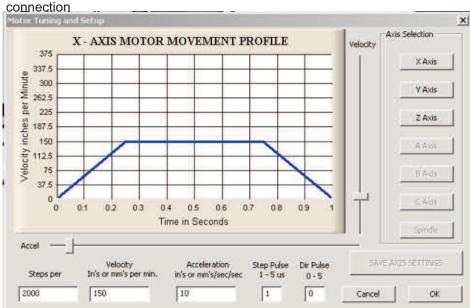
For proper tuning of MACH3 please refer to the MACH 3 manual. The exact tuning of the software is beyond the scope of this document.

Motor Tuning Screen in MACH3

Testing the BladeRunner for motor control
. In order to get motion and you need to have MACH3 running with it out of E-stop and the CP LED on the front panel active (ON). Without CP active, you will not get motion.

- Make sure all of the cables are connected.
- Power up the BladeRunner
- Load Mach3 with the proper profile (BladeRunner) and Screen
- Turn on DC Motor power using the ON button on the Front Panel
- Motors should "lock" when power comes on to the motors
- Hit the Reset button. The LED over the Reset in MACH will turn solid Green
- The CP LED on the front panel of the BladeRunner will turn solid Yellow
- Use the keyboard arrow keys to jog your machine. Don't worry if they jog the wrong way with the keys or the wrong axis jogs. We will fix that later.
- The Optional test Step and Direction Monitor will confirm that the signals are getting out to the EzPlug G251-4 Driver card. If the LED's flash and you are not getting movement the problem at and the motor drivers. Check your cables and connections carefully. The DB connectors need to be seated and the holding screws tightened for each cable. Sporadic motor movement or direction changes (without changes at the Step & Direction Monitor indicates one winding on a motor may not be making good connection

SETTING MOTOR DIRECTION

At this point you should have motion on all axis using the Keyboard keys to scroll with. In this section we will set the direction of motion for each axis and match the keyboard keys to that motion.
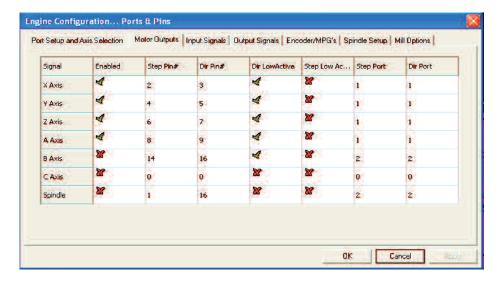
IF YOU HAVE THE MOTORS ON THE BENCH AND LABELED YOU WILL NEED TO ORIENT THEM LIKE THEY WILL BE MOUNTED ON THE TABLE AND WATCH THE DIRECTION OF TURN OF THE SHAFTS. IF YOU DECIDE TO MOUNT THE MOTORS ON THE TABLE YOU SHOULD DISENGAGE THEM FORM THE TRAVEL MECHANISM UNTIL YOU GET ROTATON DIRECTION RESOLVED. THIS IS ESPECIALLY TRUE FOR THE SLAVED MOTOR ON THE GANTY AXIS

1. Load MACH and the BladeRunner Plasma or Router Profile
2. Load the Diagnostics Tab
3. Power up the BladeRunner AIO and the DC to the motors
4. Move Each axis several inches away from the Table 0 (home switch) positions5. Zero each DRO with Zero Button next to each axis.
5. Jog the Z first. Note the Z DRO as it moves UP.
   a, If the numbers are INCREASING in value then the direction is correct.
   b. If the numbers are DECREASING then the DIR is wrong. See the next page to change the DIR of a motor
   c. The key may not match the direction of jog...do not worry it will be redefined
7. JOG the non-slaved axis next and do the same DRO check and change if it is scrolling the wrong direction.
8. The Slaved Axis is a little different. You must FIRST setup the slaving (See Page ___ earlier in this section) using the 4 axis or 5 axis instructions.
9. The DIR setting on the **SOFTWARE Slave** (A is slaved to Master axis) is opposite the Master axis (motor faces the other and spins opposite to move the same direction) **Hardware Slaving** is set via jumper on UBOB III
10. If in the setup you need to change the Master Axis DIR to make it move correclty you will also need to change the Slave Axis on a 4 axis (Software Slave) setup.

Setting up the proper axis direction and motor tuning
While the Profile file (BladeRunner.XML) provided with the unit sets up all of the pins there are several things we don't know about your machine and so certain parameters have to be set based on your specific machine. .

NOTE :   5 Axis systems use the B axis as an independent axis. Set ENABLE to Green Check mark if it is a Red X (Disabled)

Each axis has a Step and Direction pin.
At this point do not worry if the axis moves in the wrong direction, simply that you have the axis as you define them correct.

The next step is to make the axis movement agree with the DRO and g-code commands for that axis. The DRO (Digital Read Out) for each axis is at the top of the screen. You will need to take MACH3 out of E-stop by pressing the Reset button.

- Jog your machine so the cutting head is away from the Homes (approx center of the table is good). Don't worry if the jog keys aren't correct or that the DRO's are running in the wrong direction.

- If your machine is setup so that one corner is X0,Y0 (lower left corner?) then **all** moves from 0,0 should be a positive number.

- The MDI is a line to allow you to type in direct g-code commands to make the machine make specific moves. You don't need to have a deep knowledge of g-code to use it for testing.

Input

Diagnostics Tab

Direct G-Code Input

(Your MDI may look different)

- When you type in a g-code command it is not case sensitve but be sure to use zeros's and not "O's" for the numbers! **At this point do not worry about which hotkeys are assigned to a direction**.
- With the machine out of e-stop and power on, type the following into the MDI Frame:
    - Move the screen cursor to the MDI frame and click on it. The frame background color should change to yellow meaning it is ready for input. No other movement keys work when the MDI frame is selected.
    - G00 X3.0
    - Enter key activates command
- The X axis should move 3 inches in some direction It should have moved away from your established X zero and the DRO numbers should have increased. If it did not then you need to reverse the direction of axis travel.
- To reverse the direction of any axis open the Ports and Pins/ Motor Outputs and change the polarity of the **Dir LowActive** setting for that axis. Clicking the Green Checkmark or the Red X will swap the definition. Red X is posiive and Green Check is negative polarity.
- Work with each axis to establish that the movement direction is correct. Use the MDI frame and change the axis letter from X to Y then Z. **Do NOT change the polarity of the step signal (Should always be Red X for BladeRunner**

FINE TUNING the calibration using the "tape measure" method

Once you have a ballpark of the number of steps it takes to move your machine 1 inch then you can fine tune that using a simple tape measure and a calculator

1. Establish a zero spot you can precisely mark on your table. On a plasma table you need to remove the torch and either mount a laser pointer at tool center or use a sharp pointed tool in a holder. You can also tape a small drill bit or pointer to the torch nozzle if your mount has enough room. You want something small enough you can see errors of .032 on the marks of the tape.

2. Setup up the axis you want to calibrate with the pointer sitting at the zero point and zero that axis DRO.

3. Write down the Steps per Unit value you have for that axis.

4. Open MACH to the Diagnostics Page and find the MDI window

5. Type in a distance to send that axis out using the following G-Code (example is for moving X out 30 inches) **HIT THE ENTER Key to execute the line**

Direct G-Code Input

G00 X30.000

6. Measure the ACTUAL distance you went with your tape measure from zero to where it stopped and write down the distance to as close a decimal value as you can (estimate the distance if it's less than a 1/16 (.063).
7 **BEFORE YOU make ANY changes** move the axis back to the start point by using the MDI and typing G00 X0.000 (for the example above)
8, Use the formula On the next page and calculate the new Steps per UNIT. Then open the motor tuning in MACH and make the change. Run the same test again (you should be MUCH closer. Once you are as close as you can see by eye at 30 inches do one final test at the longest point on that axis. Typically if you are within .032 at the end of the move, you will be within 4 decimal points at 1 inch.

BladeRunner 620 Stepper Motor Dimensions

Use # 8-32 mounting screws (4mm)

2.351
1.856
.172d
2.351
1.856

3.969
.265
.375
.058
.940
1.498

☐ DIMENSIONS
Dimensions in Inches

BIPOLAR & UNI-POLAR

☐ COLORS OF LEAD WIRES

SERIES CONNECTION

EIGHT WIRING CONNECTION

RED A
YEL Ā
BLU C
BLK C̄

WHT PUE BRN GRN

☐ SPECIFICATIONS   unit=mm

CONNECTION WISE	EIGHT WIRING				SERIES CONNECTION			
PHASE	2	PHASE			2	PHASE		
STEP ANGLE	1.8±5°/STEP				1.8±5°/STEP			
VOLTAGE	V	3.5	V		5.0	V		
CURRENT	3.5	A/PHASE			3.5	A/PHASE		
RESISTANCE	1	±10	Ω/PHASE		2	±10	Ω/PHASE	
HOLDING TORQUE	400	N.cm			437	N.cm		
INSULATION CLASS	B				B			
LEAD STYLE	FF46-1/0.5				FF46-1/0.5			
NO. OF LEADS	8				4			

TAG	PLACE	CHANGE	NAME	DATE
DESIGN			STD.	
CHECK			APPROVE	
PROC.				

DESIGN

MASS   PLATE   SCALE

N/R

FORMULA FOR CALIBRATING
Steps per Unit on an axis

Steps per unit in MACH

Current Setting in Steps per UNIT   = Sc
Actual Distance Traveled   = Dt
Commanded Distance (you entered) = Dc
New Steps per Unit value   = Sn

$$(Sc \times Dc)/Dt = Sn$$

Sn is in steps and will probably a decimal number
Set the decimal amount to 3 decimal places

**Servo
Addendum G**

ADDENDUM SECTION ADDED 11/15/12
For BladeRunner AIO Dragon-Cut SERVO
products
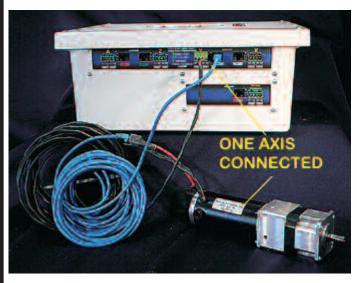
The following 6 pages are for the SERVO motor version of the BladeRunner Dragon-Cut and cover the setup and tuning of a system with servo. The Drive tuning is done at the factory and seldom needs to be changed but some mechanics may require some tweeks to the driver tuning.   Besides the change of the tuning in MACH (calibration) and recommended settings for the servo system the Dragon-Cut will operate in the same manner. The motor gearhead combinations were engineered for optimum performance for plasma cutting. The wider torque range of the servo motors provides a better platform for mixed cutting applications (router/plasma) but the typical issues of cross contamination and change over still remain.   The Servo system does offer higher performance with increase upper cutting speeds at high acceleration rates. This does put larger stress on the mechanics so full out maximum settings are often counterproductive.

HARDWARE DIFFERENCES for BladeRunbner SERVO system

EZPlugII Servo Drive Assembly

ONE AXIS CONNECTED
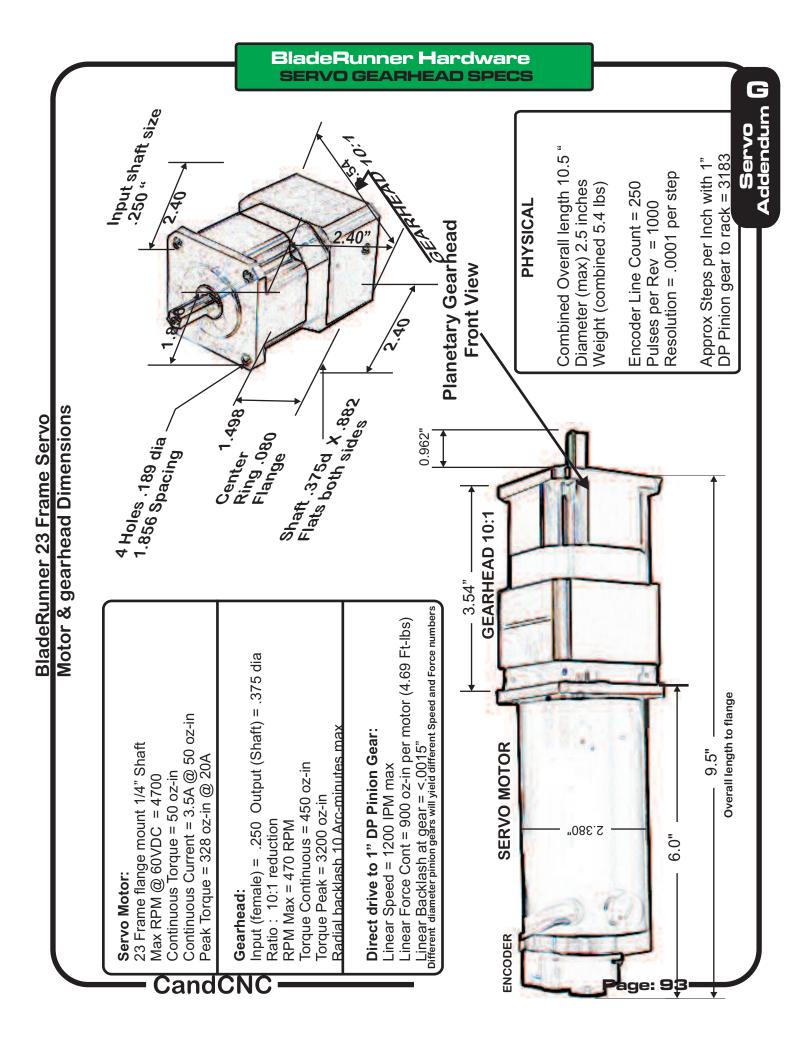
NOTE: Servo Motors use the same 4 wide motor plug as the BladeRunner Stepper systems but the pinout is different. Do NOT plug a stepper into a servo unit or vive versa!

SERVO systems use a rotary encoder mounted on the motor. Each encoder is supplied with a differential driver ("pigtail") that allows a standard CAT 5 cable to be plugged in and transmit the encoder information back to the servo interface sub-assembly. you MUST HAVE THE ENCODER CABLES CONNECTED when a motor is powered up! With no feedback to the electronics of where the motor is it will "Run Away" We have color coded the label and the cables to make it easier to identify each motor/encoder pair. Do not get the pairs mismatched/ The Inputs from the PC parallel and serial port are connected the same way as the stepper version as is the DTHCII connections (see DTHCII User Manual

Power and Encoder Plugs for Motors

OPTIONAL 5th Axis Module

Right Side View

Plug for DTHC to THS SENSOR MODULE

Inputs from PC Ports

Dual Switched AC Outlets from CODE

Home/Limit wiring knockouts

Left Side View

Servo Addendum G

BladeRunner 23 Frame Servo
Motor & gearhead Dimensions

Input shaft size .250 "

GEARHEAD 10:1

2.40

1.8

2.40"

4 Holes .189 dia
1.856 Spacing

Center
Ring .080
Flange

1.498

Shaft .375d x .882
Flats both sides

2.40

Planetary Gearhead Front View

0.962"

3.54"

GEARHEAD 10:1

SERVO MOTOR

2.380"

9.5"

6.0"

overall length to flange

ENCODER

Servo Motor:
23 Frame flange mount 1/4" Shaft
Max RPM @ 60VDC = 4700
Continuous Torque = 50 oz-in
Continuous Current = 3.5A @ 50 oz-in
Peak Torque = 328 oz-in @ 20A

Gearhead:
Input (female) = .250 Output (Shaft) = .375 dia
Ratio : 10:1 reduction
RPM Max = 470 RPM
Torque Continuous = 450 oz-in
Torque Peak = 3200 oz-in
Radial backlash 10 Arc-minutes max

Direct drive to 1" DP Pinion Gear:
Linear Speed = 1200 IPM max
Linear Force Cont = 900 oz-in per motor (4.69 Ft-lbs)
Linear Backlash at gear = <.0015"
Different diameter pinion gears will yield different Speed and Force numbers

PHYSICAL

Combined Overall length 10.5 "
Diameter (max) 2.5 inches
Weight (combined 5.4 lbs)

Encoder Line Count = 250
Pulses per Rev = 1000
Resolution = .0001 per step

Approx Steps per Inch with 1"
DP Pinion gear to rack = 3183

CandCNC

ADDENDUM SERVO MOTOR SETUP AND TUNING

The BladeRunner Servo systems ship with 4 (or 5) servo motors and on the XY motors (3) there are 10:1 gearheads. The following pages should be used to do the calculations for the calibration and to determine the best velocity and acceleration. In addition to the normal motor tuning in MACH the Gecko G320X drives have a PID set of pots that can be used to do added response tuning of each motor. **The PID settings are done during final testing prior to shipping and seldom need to be adjusted.** We have included excerpts of the tuning process from Gecko but unless you are experiencing motion induced fault issues, than **doing adjustments just to see what it does will not "fix" anything**. While different loads can alter the response of the servo it will not effect the accuracy. The servos are never at rest if they are powered up. As a result they WILL make noise. If you attempt to tune them for no noise or minimum noise you will have a "sloppy" system. Even a poorly tuned system will not allow a lot of error in position to

SERVO TUNING 101...Tuning by ear

If you don't have a dual channel oscilloscope and the experience to use it, the easiest way to tune a Gecko drive is by sound. The following covers that method and will yield good results.

DO THIS ONLY IF YOU ARE CONFIDENT THAT THE MOTORS ARE EXHIBITING SYMPTOMS OF IMPROPER TUNING!   Most problems are mechanical (backlash, loose gears/pulleys or settings in MACH) and cannot be helped with driver tuning)

 This should be done ONLY if you experience any of the following:
1. Any motor that pulses slowly or is completely quiet qhen powered and not moving.
2. An axis that faults often when you are accelerating the motion
   NOTE it is normal for a servo to fault and the ESPII to throw a fault when you do an emergency STOP in MACH. The motor cannot stop instantly without causing a fault
 Faults from other issues like overloads and noise cannot be fixed with motor tuning!
The motors need to be mounted and under load to do tuning by ear.
1. Power up the motors. It may be easier to disconnect all but one motor and encoder apir at a time so you can hear just that motor. if you accidently try to jog a motor that is not connected the Gecko drive WILL fault.
2. Make sure the motor under test "locks". If it starts to move than make sure the encoder is plugged in for that motor. If the motor losses encoder pulses (either channel) it will start to run away (spin at full speed huntting for a line on the encoder)
3. The motor should "hum". The frequency is typically below 220 hz (octive 3 A on the music scale). The important thing is that the motor does not sit and pulse indicating it is way over dampened. The higher the frequency of the "hun" the tighter the tuning. There are two main controls: The P and the D pots. The P is the gain and as you increase it the hum frequency will go up.
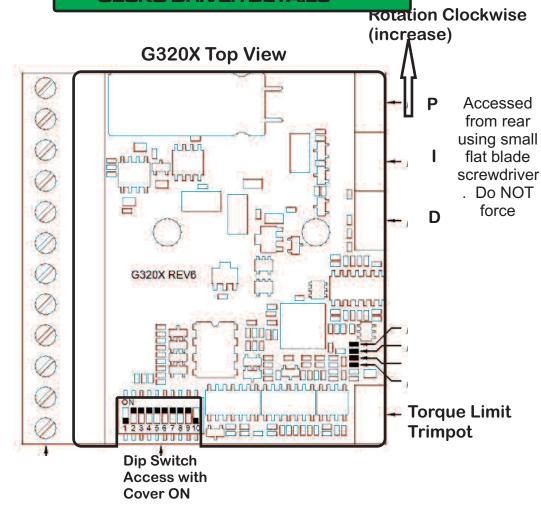
4. Start with the D pot turned   all of the way counterclockwise (minumum) and slowly advance the P pot until you either hit a point it gets unstable and the motor starts to twitch (oscillate) or you have it turned all of the way up. Make a note of the pot position and back it off until the oscillation stops and then advance it to a position below that point. Now increase the D (dampening) and listen to the frequency...it will drop. Stop the D at about 1/4 turn and then advance the P past where it became unstable before. If it starts to become unstable note the position and back it back down then advance the D some

5. Start with the D and I pot turned all of the way counterclockwise (minumum) and slowly advance the P pot until you either hit a point it gets unstable and the motor starts to twitch (oscillate) or you have it turned all of the way up. Make a note of the pot position and back it off until the oscillation stops and then advance it to a position below that point. Now increase the D (dampening) and listen to the frequency...it will drop. Stop the D at about 1/4 turn and then advance the P past where it became unstable before. If it starts to become unstable note the position and back it back down then advance the D some more and turn the P back up. The objective is to have high gain but with enough dampening to keep the loop stable under all conditions. Once you have established the highest gain (P) that you can support at a given D then back it off a little and leave the D where it is. Do not set the motor so that it is silent or pulses. After you have the P and D set raise the I and that increases the dampening curve

Once you have the motor tuned in a static (non-moving setup) connect to load, than set the tuning in MACH up to a high number (75 to 100) for acceleration and jog the motors at full speed and change direction several times. If the motor driver faults that lower the P slightly raise the dampening slightly by increasing the I setting. Once you have one motor tuned correctly listen to the frequency of the sound. Use that as a guide to tune the rest of the motors.

6. **Setting the Torque Limit Trimpot**. For 23 sized servo motors used on the BladeRunner Servo system set the Torque Limit Trimpot to ½ range (centered between full CW and CCW rotation. This limits current to 10A max. Leave Dip Switch 10 set to OFF to prevent a 20A 1 sec peak cycle.

G320X Top View

Rotation Clockwise
(increase)

P   Accessed from rear using small flat blade screwdriver. Do NOT force

I

D

Torque Limit Trimpot

Dip Switch Access with Cover ON

SW1   Not used

SW2   Current or voltage mode select
  ON – Current mode (default)
  OFF – Voltage mode

SW3, SW4, SW5 Current mode servo gain
  SW3 "ON", SW4 "ON", SW5 "ON" = Low gain (default)
  SW3 "ON", SW4 "OFF", SW5 "ON" = Medium-low gain
  SW3 "ON", SW4 "ON", SW5 "OFF" = Medium-high gain
  SW3 "OFF", SW4 "ON", SW5 "ON" = High gain

SW6, SW7 Sets the G320X pulse multiplier
  SW6 "ON" and SW7 "ON" = Step pulse times 1 (default)
  SW6 "ON" and SW7 "OFF" = Step pulse times 2
  SW6 "OFF" and SW7 "ON" = Step pulse times 5
  SW6 "OFF" and SW7 "OFF" = Step pulse times 10

SW8, SW9 Sets the G320X following error limit
  SW8 "ON" and SW9 "ON" = +/- 256 count following error limit (default)
  SW8 "OFF" and SW9 "ON" = +/- 512 count following error limit
  SW8 "ON" and SW9 "OFF" = +/- 1024 count following error limit
  SW8 "OFF" and SW9 "OFF" = +/- 2048 count following error limit

SW10 Sets the G320X current limit trimpot behavior

EXAMPLES
50 oz-in Servo motor @ 60 VDC with 10:1 gearhead and 1" dia pinion gear & direct drive:

Max possible IPM = 4700rpm/10 X 3.142 = 1476 IPM.

* linear force = 100% servo motor continious torque X gear reduction / pinion Radius = (50 Oz-in X 10) / .5 = 1000 linear oz of force

Same design but with 3:1 belt reduction from motor to pinion shaft:

* in the above calculations the motor RPM and torque numbers of 100% were used since servo motor torque does not drop off with RPM. These are maximum numbers and NOT recommended for normal cutting and rapids. High values of velocity and acceleration put maximum stress on components for little benefit.

Calculating the beginning Steps per Unit on an SERVO AXIS

Use the following formula to get a ballpark steps per unit number in MACH

Psr =   Pinion Speed increase ratio = Pitch Dia [in inches] X PI [3.1416]

Steps Per Rotation (SPR) of motor = encoder line count X 4; [250 line count = 1000]

Target Steps per Unit = (SPR X gearhead Reduction ratio/PSR)
1000 X 10 / 3.1416 = 3183.091 steps per inch

Once you have the calculated the number of steps it takes to move the axis one inch then put that number into the STEPS per UNIT of the motor.

NOTE: IF you have the Step Multiplier on the Gecko set to 2X than you must divide the Steps per Unit by 2

Based on the speed numbers you have calculated from the previous pages set you velocity to a value of 50 to 80% of that number.

NOTE: MACH can only send the number of pulses per second as set in the Kernel Speed in Ports&Pins. The number of pulses per second you need is the target RPM (max) X the SPR/60. For a target RPM of 4000 and 250 line encoder you need 40000000/60 = 66,666.0 steps per second (66 thousand) if your Kernel speed is set to 45,000 (default) than you cannot achieve 4000 RPM. The step multiplier in the G320X multiples the steps from the PC so a 2X setting makes the steps per second required from the PC to be 33,333. The trade off is that it drops the resolution by ½ as well.

Set your Beginning Acceleration to a low number like 10

Calculating the max IPM you can travel (limited by max motor RPM)
4500 RPM = 75 RPS
Kernel Speed / SPR = RPS
45000/1000 = 45 RPS
Final Speed is limited by the smaller of the above two numbers
Pinion RPM = (RPS/ gearratio) X 60
IPM = Pinion RPM X Psr

For 45,000 and 250 line encoder:
(45000/1000) = 45 RPS
Pinion RPM = (RPS/10) X 60 = 4.5 X 60 = 270 RPM
IPM = 270 X 3.1416 = 848,23

RECOMMENDED SETTINGS FOR BladeRunner Dragon Cut with 23 Frame servo motors and 10:1 Gearhead reductions

Recommened pinion DIAMETER :   1" (25mm)
Recommended belt reduction to pinion : NONE
Maximum belt reduction to pinion 2:1
Velocity XY and slave : 500 IPM (12700 mm/min)
Acceleration XY and Slave   35 to 50 IPS/sec **
Steps per unit XYA   3183.091 (1" pinion)
Velocity Z (5 turn Leadscrew) 300 IPM (7620 mm/min)
Acceleration Z :   20 IPS/Sec
Steps per unit Z = 1000 X leadscrew TPI
THC Rate (Mach setting) 20 **
Recommended Span Voltage (Cut Proffile) 4 to 8 **
Recommended plunge rate (SheetCAM) 50 - 100 IPM
Recommend DTHC Delay (SheetCAM or Cut Profile) 1.5 to 3 sec

** These settings may need to be adjusted depending on your mechanics to get smooth cuts. Always adjust one parameter at a time.

The bulk of MACH3 and the Hardware has to do with Inputs and Outputs (I/O). In the BladeRunner AIO system I/O takes several forms. Ultimately an INPUT is a signal coming INTO MACH3 from an external source as a logic level (either Active High or Active Low) MACH is setup to "watch" certain Ports and Pins (input points) and then using a term called "mapping" it assigns an INPUT to an ACTION.   The BladeRunner is unique in that it has double the number of normal inputs to a single Parallel (printer/LPT) port so you have more than the normal 5 inputs to work with.

It is important to understand how the input Port Expansion works and how the mappings are used.

The UBOB III REV15 is the hardware I/O part of the BladeRunner Ether-Cut. It takes outside inputs from the Table I/O card to sense physical switches and sets up the "sharing" of the inputs. There are two PORTS defined in the setup. PORT1 and PORT2. .   The physical inputs are individual and each one is opto-isolated and noise filtered. The Ethernet Pulse card has I/O for 2 ports of inputs and outputs

There are two things to keep in mind:

The shared inputs do not work if you do not have both base (TCP/IP Ethernet) and the MACH driver for the ESS interface loaded and it has communication with the actual ESS module

The process is controlled through a special DRIVER (plug-in) for the UBOBIII. It has to be installed and enabled and set correctly for the shared inputs to work.
   It is added during an auto-install from the CD or the Master Installer-Install file.

Unlike the conventional Parallel Port versions the Ether-Cut version handles all of the Input and output signals from MACH3 (No port pin to MACH function) The Ethernet Signal System (ESS) reads the signal FROM/TO the UBOB IIIand sends them back to MACH3 via the high speed EtherNet port on the PC.   In order to get the INPUTS to work properly BOTH processes have to work properly

When you load the Bladerrunner Ether=Cut selection on the Master Installer Menu, earlier in this manual it loads the right Drivers (plug-ins) enables them and sets their parameters. It also provides a default configuration for all of the INPUTS and OUTPUTS that are common on the BladeRunner. IT DOES NOT automatically setup MACH to use the ESS
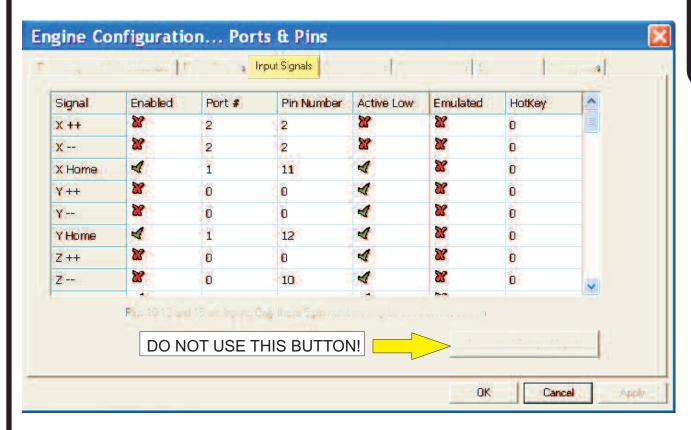
THE MOST COMMON SUPPORT CALL ON THE ETHER-CUT IS BECAUSE THE ESS MODULE IS NOT ACTIVATED IN MACH3. SEE PAGE 21 in this Manual . You **must** be able to see the ESS configuration Menu under the MACH Menu PLUGIN CONTROL If it is missing the ESS is not in communication with MACH3
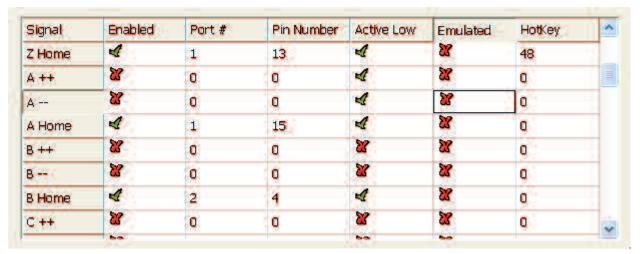
Each axis as a ++ and – which are the FAR and NEAR LIMITS. Each axis has a HOME
Each axis has an Enabled Column. **Do not use Emulated ON** (Red X for normal setups)

Engine Configuration... Ports & Pins

Input Signals

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
X ++	✗	2	2	✗	✗	0
X --	✗	2	2	✗	✗	0
X Home	✓	1	11	✓	✗	0
Y ++	✗	0	0	✓	✗	0
Y --	✗	0	0	✓	✗	0
Y Home	✓	1	12	✓	✗	0
Z ++	✗	0	0	✓	✗	0
Z --	✗	0	10	✓	✗	0

DO NOT USE THIS BUTTON! ➡

OK   Cancel   Apply

Note: A home is enabled by default. This may need to be changed if you do not software slave
A to another axis with a Home. See the setup of Homes & Limits section for details
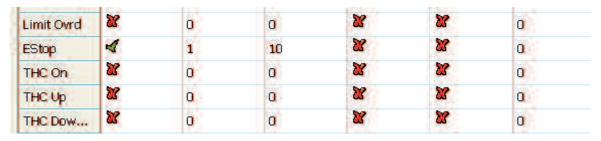
Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
Z Home	✓	1	13	✓	✗	48
A ++	✗	0	0	✓	✗	0
A --	✗	0	0	✓	✗	0
A Home	✓	1	15	✓	✗	0
B ++	✗	0	0	✗	✗	0
B --	✗	0	0	✗	✗	0
B Home	✓	2	4	✓	✗	0
C ++	✗	0	0	✗	✗	0

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
C --	✗	0	0	✗	✗	0
C Home	✗	0	0	✗	✗	0
Input #1	✓	2	3	✓	✗	0
Input #2	✓	2	5	✓	✗	0
Input #3	✓	2	15	✓	✗	0
Input #4	✗	0	0	✗	✗	0
Probe	✗	0	0	✗	✗	80
Index	✗	0	0	✗	✗	0

INPUT #1 handles the HOLD (motion) signal FROM the DTHC IV and MUST be setup as shown or the motion (XY) will continue if the torch loses arc or there is a DTHC IV fault.

Limit Ovrd	✗	0	0	✗	✗	0
EStop	✓	1	10	✗	✗	0
THC On	✗	0	0	✗	✗	0
THC Up	✗	0	0	✗	✗	0
THC Dow...	✗	0	0	✗	✗	0

E-Stop Cannot be disabled. The Active Low value is important. Note THC related signals are on PORT 8. THC ON is the same as ARC OK.

NOTE with the DTHC IV the standard 3 THC inputs ARE NOT USED.

CHECKING INPUT SIGNALS:

The following sections detail how to use the hardware interface to use Inputs and Outputs. Please review the section on the physical location of the internal cards and then the section on the Table I/O card (where Homes and Limits and other Inputs are connected. There are sections on using the E-STOP (either software or hardware or both) Setting up HOMES and testing and optional LIMITS.   Even if you do not plan to use the XY or A homes it is important to at least test each input.

Signal	Enabled	Port #	Pin Number	Active Low
Output #4	✗	0	0	✗
Output #5	✗	0	0	✗
Output #6	✗	0	0	✗
Charge Pump	✓	1	17	✗
Charge Pump2	✗	1	17	✗
Current Hi/Low	✗	0	0	✗
Output #7	✗	0	0	✗
Output #8	✗	0	0	✗
Output #9	✗	0	0	✗

THE CHARGE PUMP

The Charge Pump (CP) is an important safety signal in MACH and used by the BladeRunner. It is a 'Keep Alive" signal that is a waveform (approx 12 KHZ) and is generated by MACH and controlled by MACH and the RSS drivers.   If for any reason the power to the control system is turned on before the PC is powered up it is possible that as the PC "boots" the parallel port can have signal changes (during POST) that would might cause an output to go active.

Stepper motors require very specific signals to move, making them inherently immune to random port signals, The circuits in the BladeRunner do not allow any signal to pass to any of the drives unless MACH is fully started and is functional and the operator has brought the system out of reset. NO CP, NO OUTPUTS!

HOW IT WORKS:

MACH is programmed to turn on the CP only when MACH is loaded **and has control of the PC and the parallel port and MACH is out of RESET.** The CP going active is detected by the ESS Moduels via the Ethernet channel is IT generates the 12HHZ signal out to the UBOB card in the BladeRunner. THIS IS IMPORTANT! Whereas in previous Parallel Port versions a loss od CP if MACH was active and out of reset shows a lack of communication through the parallel port in the case of the Ether-Cut it can be from lack of communiation to the Ethernet Port, or the ESS driver (plug-in) in MACH is not activated and talking to the ESS module In the UBOB III based system the CP signal MUST be present (not just a logic level) on the CP line from the PC or the internal buffers will be disabled. No outputs will function.   **Without CP no Step signal will be sent to any motor drive (No MOTION). Without CP no relay will fire.**
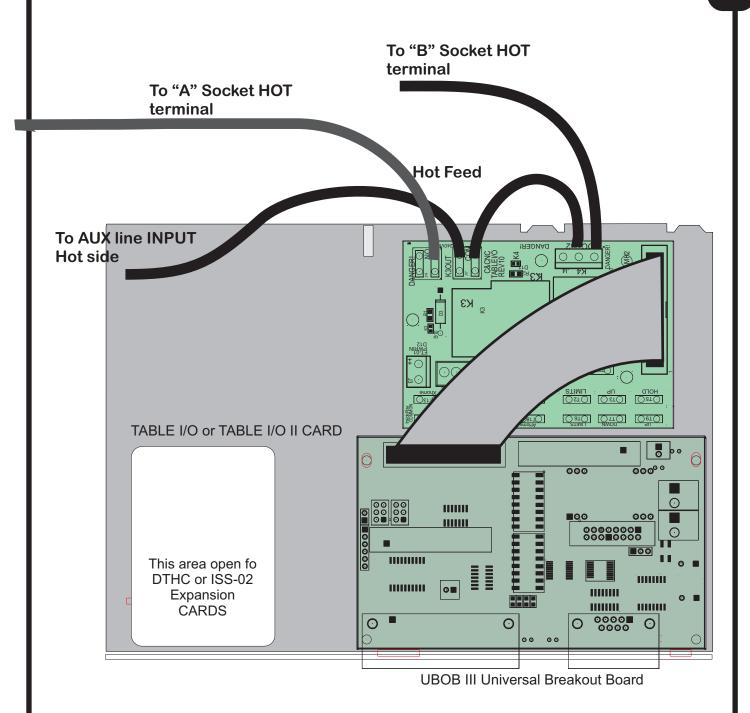
If you start MACH and the BladeRunner and you get no motion the first thing is to check the CP LED on the side of the BladeRunner. It detects and turns on the buffer circuits in the BladeRunner.

BladeRunner Ether-Cut Systems are not shipped with the older REV9 and TABLE/IO cards or with the REV 14 or sooner UBOBIII cards. If you find any reference in this manual with regards to those earlier devices disregard those references

REV 10 and later

To "B" Socket HOT
terminal

To "A" Socket HOT
terminal

Hot Feed

To AUX line INPUT
Hot side

TABLE I/O or TABLE I/O II CARD

This area open fo
DTHC or ISS-02
Expansion
CARDS

UBOB III Universal Breakout Board

Setting up HOMES.
Homes are used for establishing a known POSITION, Most often to define the TABLE ZERO locations and be able to return to the same fixed spot. Much like the address on your house versus the location of you RV at any given time. If you establish a TABLE 0 and do all of your cutting in reference to the TABLE ZERO than you can always re-establish your cut at anytime even after a power failure and E-STOP event that can cause the loss of position.
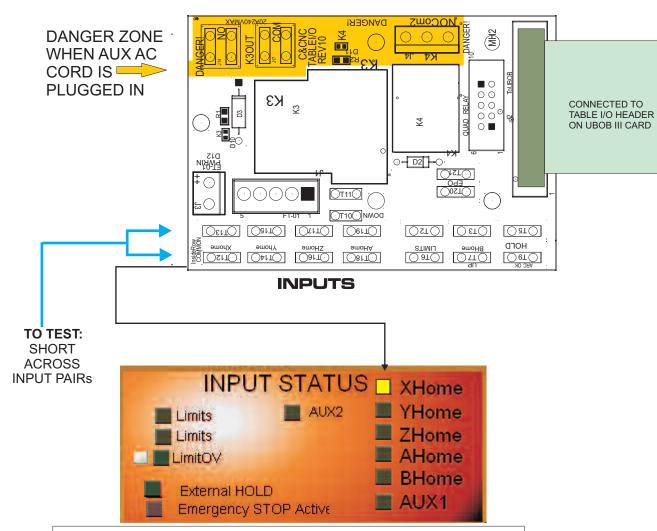
TESTING HOMES at the TABLE I/O.

If you have not yet mounted or wired your HOME switches yet, it is easy to test to make sure of there operation:

1. **UNPLUG THE AUXILLARY AC CORD T**HAT PROVIDES POWER FOR THE AC SOCKETS BEFORE YOU RUN ANY TESTS! You will need to power up the BladeRunner and the DC supply to run the INPUT tests but there is no AC high voltage in the top of the unit UNLESS YOU HAVE THE AUX AC CORD PLUGGED IN.

2. **Open the BladeRunner up** (remove the cover and place it gently off to one side leaving the cables to the Front Panel plugged in. Expose the TABLE I/O in the top of the case as shown in the illustration on page_73 Note the input terminal pairs are side by side in two rows.

3. **Power up the BladeRunner AIO** with and turn on the DC (Front Panel). You do not need the motors plugged in, but if they are it is okay. MACH will not come out of RESET if the DC power is off. Inputs do not work right if MACH is in RESET

4. **Make sure MACH3 is loaded and the BladeRunner Profile is selected**. Open the DIAGNOSTICS PAGE for the test

5. **To test the inputs** use a small screwdriver or metal object to short across a pair of inputs. Start with X Home and go down through A home.

6. Note on the TABLE I/O Card **there are small LED's next to each pair**. When you short across a pair you should see the associated LED turn on. That indicates the circuit is complete between the Input on the Table I/O and the UBOBIII. It also confirms the 25 pin cable is working.

MAKE SURE THE AUX AC INPUT CORD IS DISCONNECTED FROM THE WALL SOCKET BEFORE YOU RUN ANY TESTS

DANGER ZONE WHEN AUX AC CORD IS PLUGGED IN

CONNECTED TO TABLE I/O HEADER ON UBOB III CARD

INPUTS

TO TEST:
SHORT ACROSS INPUT PAIRs
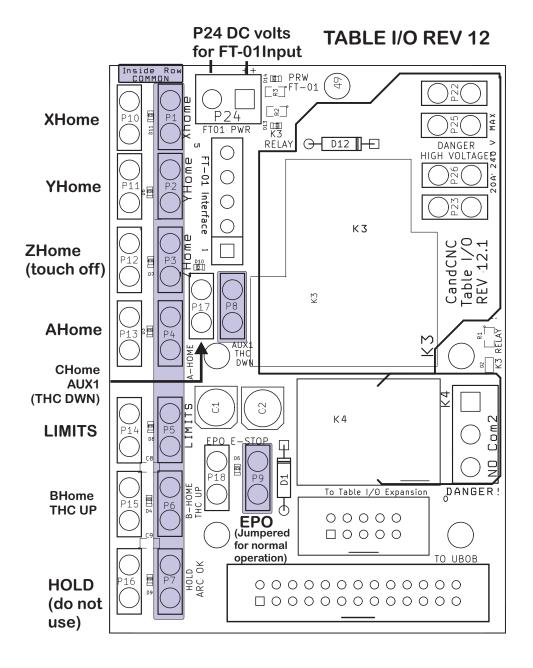
Example of testing X HOME input and indications on the DIAGNOSTICS SCREEN.   Test each input at a time and match up the INPUT STATUS.   The RAW PORT BITS shows the signal AT THE PORT 1 input on the PC as MACH sees it. NOTE: You cannot test the LIMIT input. The AUX 0 is NOT and input for the BladeRunner.

TABLE I/O CARD PINOUT
DTHC IV SIGNALS
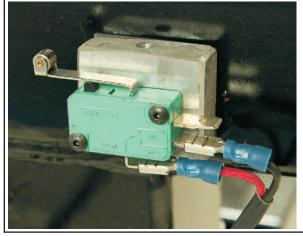
If you have a BladeRunner with the **DTHC IV** option your MACH profile maps the signals to the physical INPUTS listed below.

P24 DC volts for FT-01Input

TABLE I/O REV 12

XHome

YHome

ZHome (touch off)

AHome

CHome AUX1 (THC DWN)

LIMITS

BHome THC UP

EPO (Jumpered for normal operation)

HOLD (do not use)

Home Switch Connections: At least one Home (Z) is required if you are using the BladeRunner Dragon-Cut for plasma tables.   It is recommended you mount and connect up HOMES for the X & Y but it is not required.
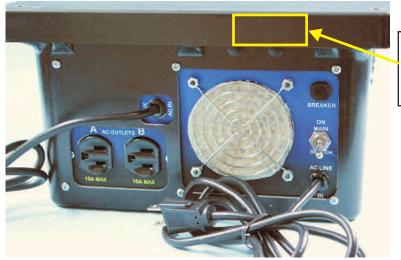
EXAMPLE of HOME SWITCH

MicroSwitch Type switch with roller lever actuator. Switch has .250 quik connects and a NO and NC set of contacts. Mouting in this case is drilled and tapped AL block with High Strength 3M double-sided tape holding it to the table frame Switch trips on bottom of gantry frame but allows it to roll past if needed.

Mount your HOME Switches so they define the X and Y zeros on your table. Mount some clips or brackets (stops) on the cutting surface or edges to let you index a sheet of material in relation to the table zero. Even if the STOPS are not exactly at table zero you can deal with the offsets in the CAM layout. **Having alignment stops on your table let you accurately remove then re-load a piece of material. Having a defined table 0, 0 that can be referenced to makes the recovery of a loss of absolute position easy** to recover from. We have provided enough inputs to allow for up to 4 Homes.

The Z home setup is covered on the next page and depends on the type Floating Torch Holder you are using.
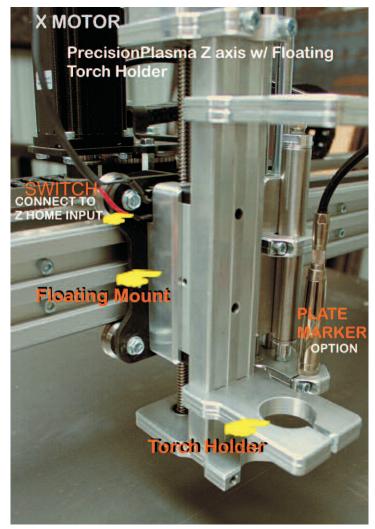
The BladeRunner AIO enclosure is furnished with 2 access holes for routing switch wires into the box for connection to the tabs on the TABLE I/O card. The holes are filled with two rubber knock-out plugs that are easily removed. HOME switch wires carry very small amounts of current (< 15ma) and low voltage (3 -5 volts DC) so the wire size is not critical. It is recommended it be stranded for flexibility on any moving part of the table and for longer runs twisted pair(s) are recommended.   Wire from 24Ga to 18Ga works best.   The smaller the conductor the more wire pairs will fit through the access holes. Use the correct sized Crimp-On connector for the size wire you use.

Switch Wire Access Plugs on End of BladeRUnner AIO
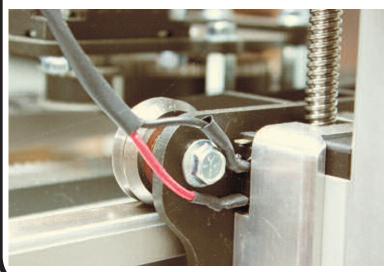
Example of a Z with the Floating Torch Holder for doing the IHS for Plasma cutting.

WHAT IS A FLOATING TORCH HOLDER and WHY DO I NEED ONE?

The Floating Torch holder is a torch holder mounted on a separate slide from the Z axis and allows the torch to move UP and DOWN independent of the Z motion. In operation it uses the end of the torch (torch tip) as a "Probe" to find the Top-of-Material. Because metal tends to warp and the slats may not be perfectly level, the Z zero changes (top of the material) as you move around the table surface. The DTHCII will track the rise and fall of the material as it cuts to hold a constant arc gap, BUT the absolute value of Z as displayed by the Z DRO is based on the LAST REFERENCE DONE. (Where it started) Each pierce needs to be done at exactly the right height above the material so a method if **Initial Height Sensing** (IHS) is needed. The Floating Torch holder lets the Torch be the sensing probe for the IHS. It is a mechanical way to do the probe and is more reliable than ohmic or capacitive sensing. Using a Z homing sequence generated by the G-Code (from SheetCAM) the Z is lowered until the tip of the torch touches the metal and the floating mount allows the torch to be pushed UP and that trisp the swtich.

Z AXIS FLOATING HEAD SWITCH. Close up of switch connections. Use Normally Open Pair.

(Precision Plasma HD Gantry and Z)
  CONNECTED TO Z HOME in BLADERUNNER on the TABLE I/O

Using an Optional Salve Side Home Switch;

It is advantageous to use a HOME on the slaved axis (in this case A). There is an input for an A HOME. If you set your inputs to have an A HOME in INPUT SIGNALS then slave the A axis the gantry will move towards the switches and stop the motor on the first one to make contact. The other axis will continue to run unitl it contacts it;s swtich . If the two sides have gotten out of sync the XY REF will let the gantry "Auto-square" itself.

If you make the bracket on one side or the other adjustable you and fine tune the position and square the gantry with the table.

If you elect NOT to use a slave axis HOME (in case you need the input for something else). You must still enable A home in the MACH Profile but map the A home to the same Port and PIN as the Master Home (Y in this example)

Typical rectangular table setup

4 motor setup (dual drive on the gantry)

Y axis

X Home SWITCH

GANTRY

Z axis w/ torch holder
Z HOME

Y Home SWITCH

A Home SWITCH

X axis

X, Y Homes
0, 0

If you stand here to run the machine then 0, 0 is lower left corner from your location. X is cross axis (short axis)

Make this Switch Bracket Adjustable

SETTING HOME SWITCH "SEEK" DIRECTION.

Each HOME Switch in the system has an associated set of parameters to define how it is used.
To access the Configuration Menu open the CONFIG/Homing&Limits window shown below. Most of the defaults will be correct. **The HOME NEG setting tells MACH which way to move to find a home switch.** After you setup your home switches you should test each one and setup the seek direction.

1. Make sure the HOME switch shows up in the Diagnostics Window when you manually activate the switch. On the Z home for a plasma setup using the floating Torch holder, manually raise the torch by hand and test the switch.

2. Do one axis at a time. In the Program Run and the Diagnostics Tab you will find a REF button next to each axis DRO. Move (jog) each axis out several inches away from it's home switch. Click the REF button on the X axis and if it starts to move AWAY from the HOME Switch, stop the motion and open the Home & Limits window and click the Home NEG indicator for that axis. Each time you click it will change the setting from a Green Check to a RED X and back. Set it to the opposite value and click OK. Re-Test the REF on the axis you changed and make sure it moves to it's Home Switch.

3. Test and set each axis Home that you have

When Homing, the Z axis on a Plasma setup should move down to the material. It will move until it trips the Z home switch then stop, IT WILL NOT AUTOMATICALLY PICK UP THE Z above the material.

Motor Home/SoftLimits

Entries are in setup units.

Axis	Reversed	Soft Max	Soft Min	Slow Zone	Home Off.	Home Neg	Auto Zero	Speed %
X	✗	60.00	0.00	1.00	0.0000	◁	◁	20
Y	✗	99.00	0.00	1.00	0.0000	◁	◁	20
Z	✗	6.00	0.00	0.50	0.0000	◁	◁	20
A	✗	99.00	0.00	1.00	0.0000	◁	◁	20
B	✗	100.00	-100.00	1.00	0.0000	◁	◁	20
C	✗	100.00	-100.00	1.00	0.0000	◁	◁	20

G28 home location coordinates

X	0	A	0
Y	0	B	0
Z	0	C	0

OK
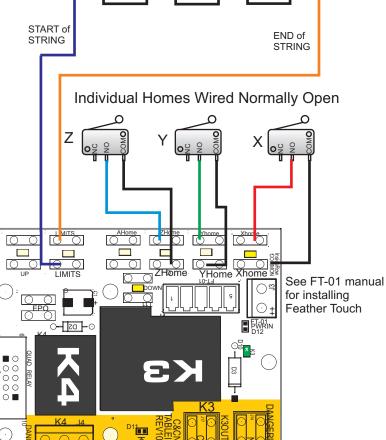
Home and limit switch hook ups

All of the inputs are opto isolated and map to a specific pin on the parallel port(s). In reality you can use any input for any signal. Inputs are not fast enough for Encoder feedback faster than a few pulses per second. The inputs use a "floating" ground (+12 return). If you need more inputs than the 8 (9 with EPO) then a PORT 2 card can be hooked to the UBOB and the added Aux and BHome inputs will work with a second parallel port.

JUMPER EPO to be able to bring MACH out of RESET
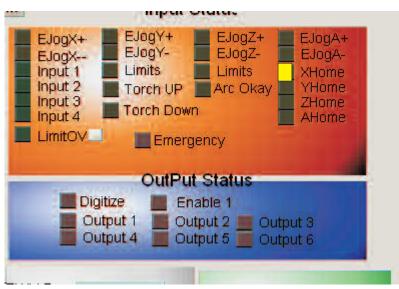
Normally closed contacts
For far limits. Wired in series

NC NO COM   NC NO COM   NC NO COM   NC NO COM

START of STRING

END of STRING

Individual Homes Wired Normally Open

Z   NC NO COM   Y   NC NO COM   X   NC NO COM

CONNECTED TO TABLE I/O HEADER ON UBOB III CARD

HOLD   UP   LIMITS   LIMITS   AHome   ZHome   YHome   Xhome

ZHome   YHome   Xhome

Install Row COMMON

DOWN

FT-01

See FT-01 manual for installing Feather Touch

FT-01 PWR IN D12

EPO

K4

QUAD RELAY

K4   J4

K3

D11   K4

DANGER!

NOCom2   DANGER!

C&CNC TABLE I/O REV10

K3   K3OUT   DANGER!

20A 240V MAX

The X Home should light up when you manually activate X Home switch. It should be off when the switch is not active. If it is reversed (i.e. goes OFF when you activate the switch but stays on otherwise) you will need to reverse the polarity of the switch in Ports & Pins/ Input Signals. We recommend using normally open (NO) contacts on Homes and Normally Closed (NC) contacts on the far limits (if used).

The far limits are wired in series external to the Table I/O card and it is setup so breaking the string at any point activates a hard limit. The hard limits are safety switches located at points on the table to prevent the machine from going past the table travel limits. You can have far limits (opposite the 0,0 location of the table) AND near limits (at points where the machine would crash on the other side of the Home switches. Limits are optional and on stepper based systems you could elect to have just hard stops since the motors can be stalled without damage.

A NOTE ABOUT LIMITS on the BladeRunner:

A stepper motor/driver is a "torque limited system" meaning that the drives limit the amount of torque a stepper motor can apply to a load. It does that by limiting the current on each pulse. While most AC and DC motors will quickly exceed their ratings if presented with a large overload, the stepper just stalls (starts slipping) and "loses steps". Because if this they are safe from overload and will simply stop turning. Simple mechanical stops on an axis will keep motors from running to far and no damage to motor or drive is inflicted. It sounds bad because the motor vibrates as it attempts to turn but no harm is done. The motor will not overheat and the electronics will not see it as an overload unless all 4 motors are stalled at the same time. LIMITS are more for decoration than function on a stepper system. Some users like to have them. If that describes you then by all means install and set them up...you will feel much better!

SPECIAL SECTION: Hooking up a remote control for doing Oxy-Fuel cutting. Disregard this section if you do not have an oxy-fuel setup on you table.
IF YOU DO WANT TO SETUP AN OXY_FUEL SYSTEM PLEASE NOTE THE FOLLOWING:
1. Setup and copy your working Plasma Profile using the MACH LOADER covered inPage 34 of this manual.
2, Make the changes listed on the next pages to THAT NEW PROFILE.
3. You can control the Z UP and DOWN manually during flame cutting using either a set of switches OR the PC keyboard but not BOTH.
4. There may be some reconfiguration of outputs needed for oxy=fuel if you want automated control of the Oxygen valve and/or an automatic striker.
5. The THC cannot sense the height of the tip since there is no cutting volts or current to read. Typically oxy-fuel is done on thicker material and at much slower feedrates than plasma so manual height operation is possible.
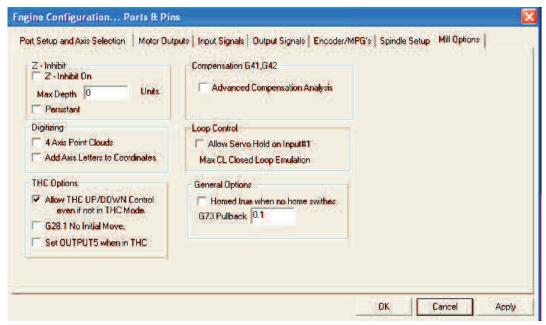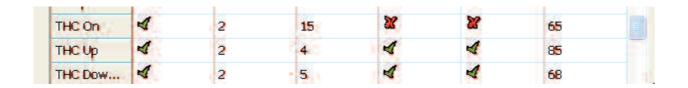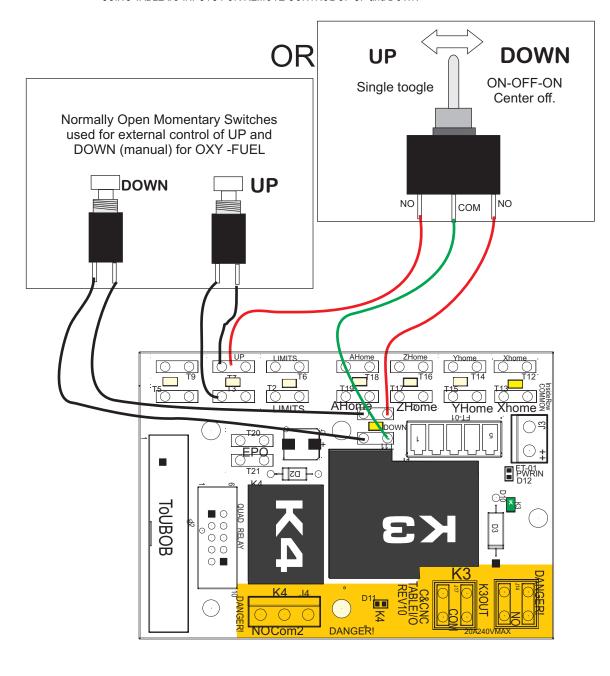
If you want to use the manual UP and DoWN inputs on the Table I/O card for controlling the Z while code is running you can use one of the switch setups on the previous page into inputs. You must then open the COFIG in MACH and select PORTS 7 PINS and the MILL OPTIONS TAB as shown. Check the "Allow THC UP/DOWN Control even if not in THC Mode" Checkbox and then APPLY button. This sets up MACH so it will listen to the UP and DOWN commands even when the THC Button is OFF in MACH.   The manual UP and DOWN is like a Z JOG command but DURING running code You cannot JOG Z with the same inputs when it is NOT running code and the Torch is fired (Output 1 active) The buttons you use *either from a pendant (table I/O inputs) or from an EMULATED input will ONLY move the Z WHILE YOU HAVE THE TORCH ON AND ARE MACH has ARC OK (not typically used with the DTHCIV   You will have to assign an input to the THC ON (Arc OK) and set the input so it is on with no signal because even though the DTHC IV reads and handles the ARC OK directly you have to make the MACH3 internal THC code THINK it has ARC OK.= for it to release Z motion.

To do the same thing using the keyboard you must setup the INPUT Pins in MACH so THC UP and THC DOWN use EMULATED enabled (green check). You can then click on the HOT KEY for each and use the Set Hotkey to select two keyboard keys. Do not use keys assigned to any other function! While you can use both hardware swtiches and the keyboard hot keys it could get confusing. We present both as options but recommend you use one of the other

G

BladeRunner
Hardware

USING TABLE I/O INPUTS FOR REMOTE CONTROL OF UP and DOWN

OR

UP   **DOWN**

Single toogle   ON-OFF-ON
Center off.

NO   COM   NO

Normally Open Momentary Switches
used for external control of UP and
DOWN (manual) for OXY -FUEL

DOWN   **UP**

UP   LIMITS   AHome   ZHome   Yhome   Xhome

T9   T7   T6   T18   T16   T14   T12

T5   T3   T2   T19   T17   T15   T13

InsideRow
COMMON

LIMITS   AHome   ZHome   YHome   Xhome

DOWN

T20

EPO

T21   D2

K4

K4

K3

ToUBOB

QUAD RELAY

ET-01
PWRIN
D12

D10   K3

D3

K3

D11   K4

K4   J4

NOCom2   DANGER!   DANGER!

C&CNC
TABLE I/O
REV10

J17   K3OUT

COM   20A240VMAX

J14

NO

DANGER!

USING OPTICAL SENSORS FOR INPUTS

WARNING Do not attempt this option unless you can read and understand the schematic and have the wiring skills to make the connections and test equipment to troubleshoot the setup..

We offer this page as an EXAMPLE as to how to wire in other types of sensors. It does not represent components or products we sell or provide in the BladeRunner. We have been asked in the past on how to do this and this page is the documentation of that request. .Please do

Detail of connection for ONE input (X HOME). All others are the same except on different pins

LED blocks higher voltage to UBOB Opto

Table I/O [HCL 301] C ARD

T13

Common Tab

Floating Ground

C2 CAP NP

D4

LED on Table I/O

T12

XHome Tab

X HOME INPUT

CON25

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Floating Ground

R2

WHT

RED

BLU

GRN

BLK

OPB917IZ Slot Opto
Qut goes low when light path is interrupted. Low signal turns on input

R3 RESISTOR

RED

R3 Values	Aux volts
330	5 VDC
680	10 VDC
820	12 VDC
1.5K	24 VDC

Table I/O

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

DC-DC Floating 9V

ON UBOB Card

+

Floating Ground

OPTO on UBOB Card

R1 RESISTOR

ISO1

X HOME

5 to 24VDC
100 ma or more

+

-

Normally a NO switch is connected across T12 and T13 terminals (XHome) and closing the switch turns on D4 through the cable to ISO1 on the UBOB. Since there are two LED's in series (equal to 4 diodes) current from the 24V side will not flow backwards through the LED's and damage anything. Reverse breakdown of LED is > than 24VDC.

AUX 5 to 24VDC Supply to match Opto switch. Do not Ground neg side of power supply to external ground or chassis. Negative side needs to connect to input circuit common (Floating Ground on the Table I/O card ONLY)

CANDCNC

In the BladeRunner system there are two forms of E-STOP:

Software (MACH3 based) E-STOP
Hardware (ESPII / UACM Card) E-STOP

SOFTWARE E-STOP

In MACH there is a manditory input for E-STOP. It is implemented as a normally closed input (must be held low to come out of RESET). That input is assigned in the BladeRunner AIO to input pin 10. With nothing attached to that pin it is pulled high by the parallal port. IF MACH is in RESET, all outputs are disabled and no inputs are acted on (ignored).

There is a general misunderstanding about software E-stop and if it is safe if the motors are still under power. The answer lays in the fact that a stepper based system like the BladeRunner HAS TO HAVE PRECISE TIMED SIGNALS to special drivers to initiate motion. It cannot simply "run away". It is virtually impossible to make a stepper motor turn without the operating software (MACH) and the electronics providing a valid pulse stream. In any failure scenario of the hardware (drive malfunction, shorted/open signals, disconnected wires, loss of power, etc) motor rotation is not possible. Since the software MUST be in control to issue pulses and the Charge Pump will turn off if the software is frozen, in a loop, or malfunctioning, putting the software into RESET for any reason will stop motion.   It is actually harder to get motion when you SHOULD have it than to have a stopped system. One of the added benefits to a stepper based control is IF IT DOES NOT HAVE VALID STEP COMMANDS IT LOCKS THE MOTORS if power is still on the drives. Any consequence of applying DC or a short to any motor winding will cease rotation and typically lock the motor. The only argument is that the input device for E-STOP might fail, but that is no more likely than a failure of a HARDWARE based e-stop.   So a failed drive will not cause a motor to Run Away. A failed computer or communications interface will not result in random or uncontrolled motion. Coupled with the Charge Pump (see section on the Charge Pump function) the probability of any motion more than .050 inches is about the same as a computer attached to a printer and no keyboard activity (no user) firing up and printing a perfect copy of the Magna Carta from random noise.
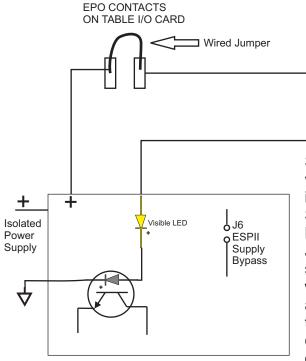
Since it REQUIRES concise control from the software to create motion the software can effectively control it going into RESET and E-STOP

The user can willfully disable Software E-STOP by setting the E-STOP input to read the wrong polarity and render the E-STOP disabled but a hardware E-stop can be disabled as well.

Implementing a SOFTWARE (ONLY) E-STOP. The BladeRunner AIO when properly setup will be put into RESET if the E-STOP (EPO) string is broken.

EPO CONTACTS
ON TABLE I/O CARD

Wired Jumper

ESPII Control relay
NC when ON

Isolated
Power
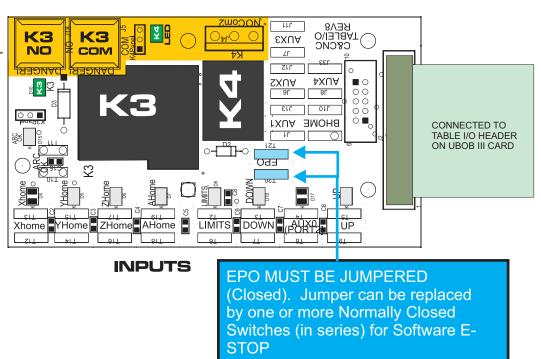Supply

+   +

Visible LED

J6
ESPII
Supply
Bypass

System is ACTIVE ON. All connections, voltages and components MUST be intact and working OR the system will Software E-STOP. Anytime power is off MACH cannot come out of reset. Jumper at EPO can be a string of "N..." switches (NC in series) that can be wired at any point on the equipment. any switch or connection in the string that open will trigger an E-stop. Once closed condition is restored the operator must inititate a RESET to bring the system back out of Software E-Stop

DANGER ZONE
WHEN AUX AC
CORD IS
PLUGGED IN

K3 NO   K3 COM

K3

K4

Xhome   YHome   ZHome   AHome   LIMITS   DOWN   AUX0 (PORT2)   UP

CONNECTED TO
TABLE I/O HEADER
ON UBOB III CARD

INPUTS

EPO MUST BE JUMPERED (Closed). Jumper can be replaced by one or more Normally Closed Switches (in series) for Software E-STOP

BladeRunner
Hardware

HARDWARE E-STOP. As an option there are connections provided for a Normally Closed Hardware E-stop that removes current flow from the Control relay. The Control relay is a small electro-mechanical DPDT relay that DIRECTLY provides power to the Main Safety Relay (AC INPUT RELAY). This is a direct shutoff with no semiconductor failure points. When the HARDWARE E-STOP is tripped the DC power is removed from the motors, dynamic braking is applied (Load Dump), a software e-stop is sent via the second set of realy contacts on the Control Relay, and the processor that controls all of the power monitor and functions is signaled. As long as the Hardware E-STOP is OPEN (tripped) than the AC is removed from the main power supply. Barring failure of *both* the processor and the control software, there is no possibility of motion from the system even if the Hardware E-STOP is pulled out of tripped condition

Switch must be Normally Closed and OPEN when pushed (or pulled on some types). If switch is mounted more than 6 ft from Front Panel card use twisted pair wire. 24 to 20 ga wire is okay.

REMOTE SWITCHES NOT INCLUDED

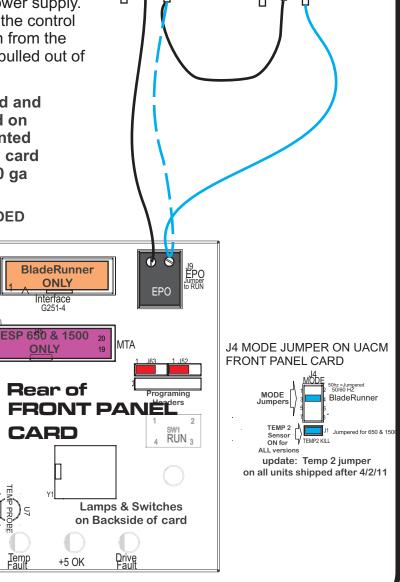**USE Dotted wiring for single switch. You can wire multiple switches in series as long as they all are Normally Closed when inactive. Pushing any swtich in the string will OPEN**

NO COM NC   NO COM NC

Serial to UBOB
J3

D19

To External DB9
on MTA Side Plate

DB9 Serial

J29

LS2
NO C NC

BladeRunner
ONLY

Interface
G251-4

EPO
J9
EPO
Jumper
to RUN

UACM

2   16
         15
1

Q6

ESP 650 & 1500
ONLY

2   20
                     19
1

MTA

1 J63   1 J52

Programing
Headers

1   2
SW1
4 RUN 3

J4 MODE JUMPER ON UACM FRONT PANEL CARD

J4
MODE

MODE
Jumpers

50hz =Jumpered
50/60 HZ

BladeRunner

TEMP 2
Sensor
ON for
ALL versions

J1
TEMP2 KILL

Jumpered for 650 & 1500

update: Temp 2 jumper
on all units shipped after 4/2/11

SIP6

1   2
STOP
SW2
4   3

Grey = no jumper

MODE
Jumpers
see
Chart

J4
MODE

TEMP 2
Sensor
ON for
BladeRunner

J1
TEMP2 KILL

Rear of
FRONT PANEL
CARD

Y1

Lamps & Switches on Backside of card

Test

CandCNC
UACM
FRONTPANEL
REV3

SW3

Test

Drives
Off

Power
Fault

Temp
Fault

TEMP PROBE
U7

+5 OK

Drive
Fault

Starting with ehr REV15 UBOBIII (used in all DTHCIV and Ether-Cut products) the outputs are direct mapped and are as shown. Output 1 is always tied to the Torch relay while output2 and output3 are tied to the AUX relays on the Table I/(card and in all Bladerunner and Plazpaks the two AUX relays are wired to the AC sockets on the end of the ESPII enclosure and ready to control AC loads up to 15A and 10A respectively (max 15A TOTAL on both at the same time)

Signal	Enabled	Port #	Pin Number	Active Low
Output #1	✓	1	14	✗
Output #2	✓	1	1	✗
Output #3	✓	1	16	✗
Output #4	✗	0	0	✗
Output #5	✗	0	0	✗
Output #6	✗	0	0	✗
Charge Pump	✓	1	17	✗
Charge Pump2	✗	1	17	✗
Current Hi/Low	✗	0	0	✗

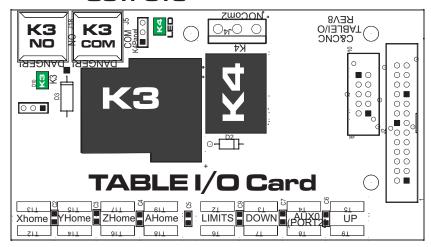**DO NOT MAKE CHANGES TO THE Charge Pump SETTINGS**

Note: the Output SIGNAL name above is mapped to a PORT/PIN pair and that defines which physical device is activated by the UBOB output section. While there are 3 signals one of them is used with the DTHC internally.

OutPut Status

Digitize
Output 1   Output 2   Output 3
Output 4   Output 5   Output 6

OUTPUTS

OUTPUT Status (Cont).   There are two AUXILLARY OUTPUT Relays on a BladeRunner EtherCut PlasmaAIO unit. They are designed as Output 2 and Output 3 on the Buttons and they toggle ON/OFF the AC Outlets A and B on the end of the BladeRunner Box. These AC outlets are wired to the AUX AC line cord on the BladeRunner. That cord must be plugged in before the outlets can be used. CAUTION there is high voltage (120VAC) at the Relays and the Outlets. DO NOT OPERATE THE BLADERUNNER WITH THE AUX AC CORD PLUGGED IN AND THE TOP COVER REMOVED.

On a BladeRunner Plasma Profile(with DTHC) OUTPUT 1 is used for turn on the TORCH Relay located out on the THC SENSOR PWM. Operation is covered in depth in the DTHCII User Manual but it is easy to simply plug in the THC SENSOR PWM module to the DTHCII module using the 25ft UTP Cable and test the TORCH ON by toggleing the TORCH button on the Diagnostics Screen and watching the TORCH LED on the front of the THC SENSOR PWM module. You can test the other two AUX outputs by plugging in the AUX AC cable and plugging in an AC load (table lamp, 120VAC FAN . etc) and toggling the individual outputs on and off.

The AUX outlets can also be turned ON and OFF from G-code using an "M" command. The M command that is used to turn on/off an OUTPUT, is a setting in MACH and comes defaulted so a M03 or M04 turns on OUTPUT1 (Torch on the Plasma Profile, Spindle on the Router Profile. M05 turns OFF either.
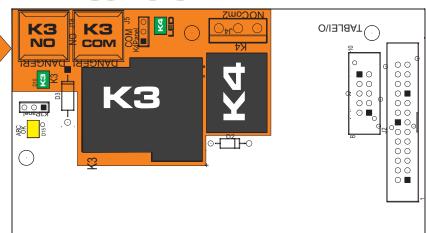
AUX AC Line Cord

BREAKER

ON MAIN

SWITCH

AC LINE

IN

AUX

AC IN

A AC OUTLETS B

15A MAX   10A MAX

Switched A Outlet K3 Relay

Switched B Outlet K4 Relay

AC Line Cord Main Power

OUTPUTS

THIS SECTION OF TABLE I/O IS Dangerous (High Voltage) When AUX AC CORD IS PLUGGED IN!

K3 NO

K3 COM

K4 LED

NOCom2

J4

K4

K3

K4

K3

DANGER!

DANGER!

D3

K3

ARC OK

D15

K3Panel

COM
K4Panel

J5

TABLEI/O

SETUP & TESTING OUTPUTS

Checking Outputs Using Diagnostics Page

Once you have established that you are getting proper inputs (see previous page) then you can test the outputs. With the BladeRunner connected and powered up and with the DC power on (Front panel White Button pushed and GREEN Led is ON) then open the Diagnostic tab

Program Run	MDI	ToolPath	Settings	Offsets	Diagnostics

Bring MACH out of RESET (Indicator on steady GREEN) If you cannot come out of RESET see previous page for ESTOP input being OFF

Ethernet Connection to PC Must be plugged in and working

Charge Pump LED (Yellow)

Output Control
- Torch Toggle
- Output2 Toggle
- Output3 Toggle

As soon as MACH is out of RESET the CP (Charge Pump) LED on the side of the Bladerunner should come on steady

No CP will inhibit ALL outputs including Motor motion signals. Nothing will turn on or move. Lack of CP shows the parallel port is not working or at the wrong port address in MACH. You can also get no CP if you are not running the correct profile or the ccc_Ubob and ccc_comm plug-in's are not active.

OutPut Status
Digitize, Output 1, Output 4, Output 2, Output 5, Output 3, Output 6

Once you have the CP on you can trip an output and it will start to *flash* in the OUTPUT STATUS. Plasma systems will have 3 ouputs (Torch is output1). Routers only have two outputs.

If you want to test the physical outputs on a Blade runner plug an AC device (lamp, fan, etc) into the A or B outlet on the end and toggle Output 2 or 3 to turn it on.

END of BladeRunner Ether-Cut Manual

Once you have setup and tested you BladeRunner EtherCut system you are ready to proceed with setting up and tuning the DTHC IV Digital Torch Height Control if you have the Plasma version of the BladeRunner. Use the DTHC IV Setup and Config Manual provided to add this feature.